DOCUMENT RESUME

ED 113 177 SE 019 688

AUTHOR	Wailes, James R., Comp.; Lampert, Harlan, Comp.
TITLE	Elementary School Science Experimental Projects--Annotated Bibliography. Revised.
INSTITUTION	Colorado Univ., Boulder. Bureau of Educational Field Services.
PUB DATE	Jul 75
NOTE	51p.; Not available in hard copy due to marginal legibility of original document
AVAILABLE FROM	Bureau of Educational Field Services, University of Colorado, Boulder, Colorado 80302 ($1.50)
EDRS PRICE	MF-$0.76 Plus Postage. HC Not Available from EDRS.
DESCRIPTORS	Achievement; *Annotated Bibliographies; *Curriculum; *Elementary School Science; Instruction; Learning; Science Course Improvement Project; *Science Courses; *Science Curriculum; Science Education; Teacher Education

ABSTRACT

This bibliography relates the various experimental studies done in elementary school science. Every attempt was made to provide a bibliography that is as comprehensive as possible. Only a selected number of the publications put out by the projects themselves are listed. Bibliographical information is provided for obtaining a continuous source of information for any project included. The address of each project headquarters is found at the beginning of each section. Where there are commercial publishers of the materials, these addresses are also given. The publication also presents a general section which includes publications relating to the new science in a general way but which cannot be grouped under any specific program. The section is divided into seven categories: (1) curriculum; (2) environmental education; (3) science and other subjects; (4) psychological foundations; (5) teacher education; (6) teaching ideas; and (7) miscellaneous (research, facilities, implementation, etc.). (Author/EB)

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Annotated Bibliography

ELEMENTARY SCHOOL SCIENCE EXPERIMENTAL PROJECTS

compiled by
JAMES R. HAILES

assisted by
HARLAN LAMPERT

Revised July, 1975

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TABLE OF CONTENTS

Introduction 1

American Association for the Advancement of Science Commission on Science Education (AAAS) 2-7

Child Structured Learning in Science (CSLS). 8

Conceptually Oriented Program for Elementary Science (COPES) . . . 9-10

Elementary Science Study (ESS) 11-14

Elementary School Science Project (ESSP-California). 15-16

Elementary School Science Project (ESSP-Illinois). 17-18

Elementary School Science Project (ESSP-Utah). 19

Minnesota Mathematics and Science Teaching Project (MINNEMAST) . .20-22

Science Curriculum Improvement Study (SCIS). 23-29

School Science Curriculum Project (SSCP) 30

General. 31-47

Unified Science and Mathematics in Elementary School 48

Individualized Science 48

INTRODUCTION

It is hoped that this bibliography will give school personnel assistance in following the progress of the various experimental studies in elementary school science.

Two additional volumes are valuable in keeping up with current developments. The Report of the International Clearinghouse on Science and Mathematics Curricula Developments is produced annually as a joint project of the American Association for the Advancement of Science and the Science Teaching Center, University of Maryland. A request (to be placed on a mailing list for subsequent publications) should be directed to Dr. J. David Lockard, Director, Science Teaching Center, University of Maryland, College Park, Maryland 20742.

One periodical journal is particularly helpful as a reference for the experimental projects. The Editorial Staff of Science and Children, the elementary science journal of the National Science Teachers Association, publishes several articles each year concerning the new programs. Address requests to Science and Children, National Science Teachers Association, 1742 Connecticut Avenue, N.W., Washington, D.C. 20009.

Every attempt was made to make this annotated bibliography as comprehensive as possible. Only a selected number of the publications put out by the projects themselves are listed. A comprehensive list appears in the International Clearinghouse and in the Newsletters.

Those interested in obtaining a continuous source of information for any project are encouraged to write to the project headquarters and request being placed on the mailing list for newsletters. The address of each is found at the beginning of each section. Where there are commercial publishers these addresses are given at the beginning of each section.

As a further source of information, the reader may contact the Educational Resources Information Center (ERIC). The center for science education is ERIC Information Analysis Center for Science Education, Ohio State University, Columbus, Ohio.

Our thanks are directed to the Bureau of Educational Field Services at the University of Colorado for the distribution of this bibliography and to numerous graduate students who have assisted in the compilation.

University of Colorado
Revised June, 1971

James R. Wailes
Professor of Science Education

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SCIENCE - A PROCESS APPROACH

American Association for the Advancement of Science
Commission on Science Education

Funded by the National Science Foundation

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600 Madison Avenue
New York, New York 10022

AAAS Commission on Science Education Newsletter, 1515 Massachusetts Ave., N.W. Washington, D.C. AAAS Misc. Publication. Periodic publication of the AAAS reporting on the progress of the project.

AAAS The New School Science. The Corporation, Misc. Publication. 63-6, (1963). Presents several views on changes occurring at the secondary level. Most of the discussion is germane to elementary science.

AAAS Commission on Science Education. An Evaluation Model and Its Application, The Corporation, Misc. Publication. 65-9, (1965), 99 pages.

AAAS Commission on Science Education. A Guide to Inservice Instruction, (Experimental Edition). The Corporation, Misc. Publication. 67-9, (1967). Provides valuable information to those interested in doing inservice work with teachers.

AAAS Commission on Science Education. Science - A Process Approach Commentary for Teachers. (Third Experimental Edition). The Corporation. Misc. Publication. 68-4, (1968). A guide for teachers.

AAAS Commission on Science Education. An Evaluation Model and Its Application. The Corporation. Misc. Publication. 68-4, (1968), 238 pages.

Alexenberg, Melvin L. "Biology Education in the Elementary School: The First Task and Central Purpose." The American Biology Teacher, Vol. 29 (March, 1967), pp. 175-9. A plea for encouraging the "joy and excitement" of science backed up by thoughts of several eminent scientists on the teaching of science to elementary school age children.

Atwood, K., et al. "Evaluation of a Hybrid Elementary Science Curriculum Utilizing Behavioral Tasks." School Science and Math, 72, (October, 1972), pp. 644-46. Results of a study in KY school district using SAPA and ESS as compared to content-centered curriculum. Evaluation was based on specific process behavioral objectives.

Ayers, Jerry B. "Evaluation of the Use of Science: A Process Approach with Pre-School Age Children." Science Education, Vol. 52, No. 4, (October, 1969), pp. 329-334. Discusses the effectiveness of the AAAS science program with pre-school age children.

Ayers, Jerry B. and Mason, George E. "Differential Effects of Science: A Process Approach Upon Change in Metropolitan Readiness Scores Among Kindergarten Children." The Reading Teacher, Vol. 22, No. 5, (February, 1969), pp. 435-37. A report on a study.

Ayers, Jerry B., Ayers, M. N. "Influence of Science - A Process Approach on Kindergarten Children's Use of Logic in Problem Solving." School Science and Math, (December, 1973), pp. 768-771. Positive effects of Science - A Process Approach tested by Piagetian conservation tasks.

Bikle, Charles L. "AAAS Cooperative Committee Celebrates 25th Anniversary." Science Teacher, (April, 1966), pp. 38-39. Brief history of AAAS and its purposes.

Brakken, Earl W. "The Meaning of Process Approach." The Instructor, Vol. 76 (January, 1967), pp. 21+. Discussion of the "process approach" in general with specific attention given to the AAAS project.

Bredderman, T. "Elementary School Science Experience and the Ability to Combine and Control Variables." Science Education, Vol. 58, (October, 1972), pp. 457-469. Discusses Science - A Process Approach, Piaget and Inhelder, and acquisition of skills of combining and controlling variables during the upper elementary grades.

Brode, Wallace R. "Physical Science in the Early Elementary School." American Journal of Physics, Vol. 32, (November, 1964), pp. 825-830. Discussion of the process centered approach, utilizing observation, description, measurement, communication, classification, inference and prediction.

Butts, D.P. "Relationship of Problem-Solving Ability and Science Knowledge." Science Education, 49 (March, 1965), pp. 138-46.

Butts, D.P., and Raun, C.E. "Study in Teacher Attitude Change." Science Education, 53, (March, 1969), pp. 101-104. Discussion of attitude change in Science - A Process Approach teachers.

Butts, D.P., and Raun C.E. "Study of Teacher Change." Science Education, 53, (February, 1969), pp. 3-8. Study of patterns of pre-service education in science teachers - competance in science being the key objective in teacher education programs.

Campbell, Louise (Editor). "AAAS Commission on Science Instruction." Science Education News, (December, 1962), AAAS Misc. Pub., 62-14. Discussion of the formulation of the Commission to stimulate the development and trial of texts and text materials, teachers' guides, and other aids.

Campbell, Louise (Editor). "Science in the Kindergarten and Early Grades." Science Education News, (November, 1963), AAAS Misc. Publ, No. 63-20. A description of initial work and philosophy of the Commission during the summer of 1963.

Capie, R. "Science - A Process Approach II; repeat." Science and Children, 12, (January, 1975), pp. 28-29. A review of S-APA II revision as it relates to purchase, sequence and flexibility of teaching contact.

Crutchfield, R.S., and Covington, N.J. "Facilitation of Creative Problem Solving." Programmed Instruction, 1965, pp. 4.

Cunningham, John D. "Elementary School Biology Revisited." Science Education, Vol. 42, No. 2, (March, 1968), pp. 181-189. A survey of biological element in current elementary school science.

Cunningham, John D. "New Developments in the Elementary School Biology." The American Biology Teacher, Vol. 28, No. 3, (March, 1966), pp. 194-198. Gives brief description of the role of the SCIS, ESS, AAS, and EESP Programs in teaching biology in the elementary school.

"Curriculum Revision in the Sciences." Grade Teacher, Vol. 85, No. 5, (January, 1968), pp. 83-86. A number of the curriculum projects are related and compared.

Curtis, William C. "New Perspectives in Science Teaching." Social Science and Mathematics, Vol. 66, (October, 1966), pp. 655-60. Brief review of past methods used in teaching science and predictions as to new methods for the future, including a discussion of the "process approach" and two of its weaknesses.

Gagne, Robert M. "Elementary Science: A New Scheme of Instruction." Science, Vol. 151, No. 3706, (January 7, 1966), pp. 49-53. Description of AAAS Commission on Science Education programs. Brief discussion of the "content" view and the "creativity" views.

Gagne, Robert M. and Paradise, N.E. "Abilities and Learning Sets in Knowledge Acquisition." Psychological Monographs, 75: No. 14, (Whole No. 518), 1961. This paper provides information on the psychological basis for SAPA.

Gagne, Robert M., Mayor, John R., Garstens, Helen L. and Paradise, N.E. "Factors in Acquiring Knowledge of a Mathematical Task." Psychological Monographs. Vol. 76, No., 7, (Whole NO. 516), 1962. This presentation provides insight into the basis of SAPA.

Hall, Gene E. "Teacher-Pupil Behaviors Exhibited by Two Groups of Second Grade Teachers Using Science - A Process Approach," Science Education, Vol. 54, No. 4, (October-December, 1970), pp. 325-334. The article discusses the differences between those teachers and pupils using the AAAS program and those who are not using a recently developed science curriculum.

Harty, H. "Describing Selected Aspects of Science - A Process Approach," installation, New York and Pennsylvania. School Science and Math, Vol. 73, (October 1973), pp. 556-562. Discussion of implementation statistics - time used in class, acquisition of behaviors and skills, transfer and teacher attitudes.

Harty, H. "Science Instruction in ERIE Demonstration Schools Prior to the Installation of Science - A Process Approach." School Science and Math, Vol. 72, (November, 1972), pp. 697-703. "Before" (and some after) implementation data; quantitative as well as qualitative.

Harty, H. "Statistical Report of S-APA Exercises Actually Taught (1968-1969) With Identification of Progress: Problems and Suggestions for Problem Solution; New York and Pennsylvania." School Science and Math, (March, 1972), pp. 254-261. Implementation report with discussion of specific grade levels (K-3) and specific activities.

Howe, Ann C. and Butts, David P. "The Effect of Instruction on the Acquisition of Conservation of Volume." Journal of Research in Science Teaching. 7: 371-357, No. 4, 1970. Fourth and sixth grade children given instruction using SAPA were compared with children not receiving instruction on the attainment of volume concepts and a hierarchy test. Differences at the fourth grade on one of the tests were not consistent in sixth grade, and the tests of learning hierarchies showed differences for all groups.

Huff, P. and Languis, M. "Effects of the Use of Activities of SAPA on the Oral Communication Skills of Disadvantaged Kindergarten Children." Journal of Research Science Teaching, Vol. 10, #2, 1973, pp. 65-73. Study indicates that SAPA activities will enhance oral communication and transmitting (speaking) skills of disadvantaged kindergarten children.

Johnson, Janice K. "Effects of the Process Approach Upon I.Q. Measures of Disadvantaged Children." Science Education, Vol 54, No. 1, (January-March 1970), pp. 45-47. The author discusses how the ability to think rationally in disadvantaged children can be brought about by the process approach.

Krockover, Gerald H. and Glass, Lynn W. "Adding Process to Your Elementary Science Content Unit." School Science and Mathematics, Vol. 54, No. 4, (April, 1969), pp. 297-299. An example is presented as to how processes might be added to traditional science units.

Kurtz, Edwin B. "Help Stamp Out Non-Behavioral Objectives." The Science Teacher, Vol. 32, No. 1, (1965), pp. 31-33. The author who has been closely associated with the project SAPA presents a rationale for behavioral objectives.

Kurtz, Edwin B., Jr. "Biology in Science - A Process Approach." The American Biology Teacher, Vol. 29, No. 3, (March, 1967), pp. 192-196. Biological exercises of the AAAS program are classified by science process and grade level, K-6. Behavioral objectives for some of the biological exercises are summarized.

Kurtz, Edwin B., Jr. "Photosynthesis and Respirations." Science and Children, Vol. 5, (October, 1967), pp. 39-45. A description of inservice work using Science - A Process Approach.

Kurtz, R. and James R.K. "Implementation of an Integrated Program of Science - A Process Approach and Nuffield Mathematics." School Science and Math, Vol. 75, (March, 1975), pp. 258-266. Discussion of the preparation of a non-redundant math-science program using S-APA and Nuffield Math as the sources of activities.

Livermore, A.H. "AAAS Commission on Science Education." Journal of Research in Science Teaching, Vol. 2, (1964), pp. 271-282. The AAAS program in detail.

Livermore, A.H. "Science - A Process Approach." Science and Children, Vol. 1 (May, 1964), pp. 24-25. The stress of this program is mainly on the investigation of problems and situations.

Livermore, A.H., "Science in Grades K-12: A Prelude to Biochemistry." Federation Proceedings, Vol. 24, (July-August, 1965), pp. 1

Loadman, W.E. and Mahan, J.M. "External Consultant and Curriculum Change Strategies; Elementary Science in New York and Pennsylvania." Theory into Practice, 11, (December, 1972), pp. 329-339. Descriptions and definitions of consultants' roles in curriculum implementation.

Lockard, J. David, Compiler. "AAAS Commission on Science Education (Mayor-Livermore)." Third Report of the Information Clearinghouse (see first entry under General Section), pp. 1. A complete report on the project through March, 1964. Includes lists of publications and future plans.

Lockard, J. David, Compiler. "AAAS Commission on Science Education." Report of International Clearinghouse on Science and Mathematics Curriculae Developments. (See first entry in General section), 1967, pp. 174-178. A current description of the project.

Lockard, J. David, Editor. "AAAS Commission on Science Education." Sixth Report of the International Clearinghouse on Science and Mathematics Curriculae Developments. (See first entry in General section), 1968, pp. 150-153 and 395. A progress report on the project.

Lockard, J. David, Editor. "Science - A Process Approach." Seventh Report of the International Clearinghouse on Science and Mathematics Curriculae Developments. (See first entry in General section), 1970, pp. 524-528. A current description of the project.

Lockard, J. David, Editor. The Ninth Report of the International Clearinghouse on Science and Mathematics Curriculae Developments, 1974, pp. 362. Provides a detailed progress report.

Mahan, J.M. "Notes from a Consultants Diary: Concerns for Elementary School Innovators." Elementary School Journal, 71, (April, 1971), pp. 368-372. Anecdotal report on efforts of implimenting S-APA in one school.

Mahan, J.M. "Regional Action Network of Professor-Consultors: A Replicable Curriculum Change Mechanism; Elementary Science in New York and Pennsylvania." Educational Technology. Vol. 12, (April, 1972), pp. 58-60. Discussion of "RAN" as force in S-APA implementation.

Mayor, John R. "Science and Mathematics in the Elementary School." The Arithmetic Teacher, Vol. 14, (December, 1967), pp. 629-35. Description of preparation of instructional materials, experiments and experiences of the program, "Science - A Process Approach."

Mayor, John R. and Livermore, Arthur H. "A Process Approach to Elementary School Science." School Science and Mathematics, Vol. 64, No. 5, (May, 1969), pp. 411-416. Presents a description and progress report of AAAS.

McKeon, Joseph E. "A Process Lesson in Density." Science and Children, Vol. 4, No. 4, (December, 1966), pp. 21-23. A specific lesson designed along the model used in AAAS.

National Science Foundation. "AAAS Commission on Science Education." Science Course Improvement Projects, (July, 1964), pp. 13. Workington: U.S. Government Printing Office. A brief description of the work of the commission.

Nay, M.A., et al. "Process Approach to Teaching Science: Elementary Junior High School Process-Approach Science Project." Science Education, Vol. 55, (April, 1971), pp. 197-207.

Newport, J.F. "Comparison of Viewpoints on Process-Centered Instructional Objectives." School Science and Math, Vol. 74, (November, 1974), pp. 614-619. Questions are raised as to the specificity that "process" has been defined, and its possible implications for the developed programs.

Newport, J. "It's Time for a Change." School Science and Math, Vol. 65, (November, 1965), pp. 725-728. Discusses importance of new equipment and where it should come from. References are given to AAAS Science - A Process Approach and ESS, Watertown, Mass. with specific equipment mentioned.

Newport, John F. and McNeill, Keith. "A Comparison of Teacher-Pupil Verbal Behavior Evoked by Science - A Process Approach and by Textbooks." Journal of Research in Science Teaching, 7: 191-195, 1970. Purpose: To compare teacher-pupil verbal interaction patterns evoked by lesson plans from the Science - APA and teachers using ordinary lessons before and after instruction. Significant differences were found.

Panush, Louis "Twenty-Five Years of the AAAS Cooperative Committee on the Teaching of Science and Mathematics." School Science and Mathematics, Vol. 67, No. 5, (May, 1967), pp. 395-400. A review of some of the work of the AAAS Cooperative Committee on the Teaching of Science and Mathematics.

Ritz, William C. and Raven, Ronald J. "Some Effects of Structured Science and Visual Perception Instruction Among Kindergarten Children." Journal of Research in Science Teaching, 7: 179-186, 1970. This study examines the effects of SAPA and the Frostig Program for the Development of Visual Perception on the attainment of reading readiness. The class time devoted to these instructional programs did not improve or detract from performance on reading readiness.

Science - A Process Approach. Parts One to Seven and Commentary for Teachers. AAAS Publication, (1965), 65 - 14 to 21.

Scott, H.V. "Taxonomy of Educational Objectives as a Curriculum Analysis Tool: A Solution to Some Problems Encountered While Coding Activities." Science Education, 56, (July, 1972), pp. 411-415. Discussion of strengths and weaknesses and how the weakness in the taxonomy can be modified in the process of making a cognitive analysis of a new curriculum proposed.

Simmons, J. and Esler, W. "Investigating the Attitudes Toward Science Fostered by the Process Approach Program." School Science and Math, 72: (October, 1972), pp. 633-36. Report of positive attitudes towards science by children exposed to 1-3 years of S-APA; compared to less positive attitude of children using traditional curricula.

Simpson, R.D. "Comparison of Biologic Content in Three Elementary School Science Curriculum Projects; ESS, S-APA, SCIS." American Biology Teacher, 36, (May, 1974), pp. 340-343. Discussion of biologic content of programs in terms of the inherent structure of the specific program.

Smith, Herbert A. "Educational Research Related to Science Instruction for the Elementary and Junior High School. A Review and Commentary." Journal of Research in Science Teaching, Vol. 1 (1963), pp. 199. Prepared for the AAAS Commission on Science Education. Presents the results of research which has influenced most heavily current educational practice.

Stocking, S. "Reply and Rejoinder to Comparison of Biologic Content in Three Elementary School Science Curriculum Projects; ESS, S-APA, SCIS." American Biology Teacher, Vol. 37, (February, 1975), pp. 119-120. Letter and answer about November, 1974 article - an extent of implementation and amount of and extent of sequential development through the grades (of the programs).

(No Author.) "The Necessary Nine." Grade Teacher, Vol. 85, No. 5, (January, 1968), pp. 87-90. In the opinion of the author, teachers should know about these elementary science curriculum revision projects. All nine suggest practical ways to change curriculum.

"The Process Method of Teaching Science." Grade Teacher, (January, 1966), pp. 60-61+, 62-74+. Discusses the "process approach to science" developed by AAAS along with adapted units.

The Psychological Bases of Science - A Process Approach. AAAS Misc. Publication, 65-8, (1965), 35 pages.

Walbesser, Henry H. "Curriculum Evaluation by Means of Behavioral Objectives." Journal of Research in Science Teaching, Vol. 1, (1963), pp. 296-301. Report on the design and rationale for the study of evaluation of new curriculum materials for elementary science being developed by the Commission on Science Education of AAAS.

Walbesser, Henry H. "Science Curriculum Evaluation: Observations on a Position." The Science Teacher. (February, 1966), pp. 34-39. Presents the AAAS position of creating sequential materials from the behavioral point of emphasis.

Walbesser, Henry H. and Carter, Heather L. "Acquisition of Elementary Science Behavior by Children of Disadvantaged Families." Educational Leadership, Vol. 25, (May, 1968), pp. 741-747. Thorough discussion of objectives and curriculum design of the "Science - A Process Approach" project with a research study teaching whether these materials can be used successfully with disadvantaged children as well as those from advantaged home environments.

Walbesser, H.H. and Carter H.L. "The Effect on Test Results of Changes in Task and Response Format Required by Altering the Test Administration from an Individual to a Group Form," Journal of Research in Science Teaching, 7: 1-8, 1970. The results of this study indicate that the use of group format tasks may cause an underestimate of student attainment.

White, M.A., et.al. "Study of Contrasting Patterns of Inservice Education." Science Education, 53: 13-19, February, 1969. Study of patterns of pre-science education on competence in science and attitudes towards science.

Wideen, M.F. "Comparison of Student Outcomes for Science - A Process Approach and Traditional Science Teaching for Third, Fourth, Fifth, and Sixth Grade Classes: A Product Evaluation." Journal of Research Science Teaching, 12: (January, 1975), pp. 31-9.

Wilson, J.T. and Koran J.J. "Science Curriculum Materials for Special Education Students." Education and Training for the Mentally Retarded, 8: April, 1973, pp. 30-32. Describes the modifications that might be called for when adapting S-APA for use with a wide range of special children.

The Florida State University

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Lockard, J. David, Compiler. "Child Structured Learning in Science," Seventh Report of the International Clearinghouse on Science and Mathematics Curricular Developments, (see first entry under General section), 1970, pp. 307-310.

Matthews, Charles C. and Phillips, Darrell G. Handbook for the Application of the Science Curriculum Assessment System, Florida State University: Department of Science Education, 1963.

New York University

COPES - CONCEPTUALLY ORIENTED PROGRAM FOR ELEMENTARY SCIENCE

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4 Washington Place
New York, New York 10003

Center for Field Research
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New York University
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New York, New York 10003

Anundsen, Dristin. "Great Ideas Examined by Small Scientists in Test of New 'Anti-Illiteracy' Curriculum," The New York University Alumni News, Vol. 12, No. 9, (June, 1967), pp. 9.

Barnard, J.D. "COPES: The New Elementary Science Program" Science and Children, (November, 1971), pp. 9-11. Discussion and description of major aspects of the program.

Barnard, J.D. "This I Believe About Science for Children." Science and Children, 10, (October, 1972), pp. 4. Goals and values in science education by the Associate Director of COPES.

"Conceptually Oriented Program in Elementary Science," Science and Children, Vol. 4, No. 8, (May, 1967), p. 20. Statement of Objectives and present and future activities of the COPES Project.

Cutler, Janice A. "Background of the COPES Project," Project Report: Conceptual Schemes in Science: A Basis for Curriculum Development, Charles R. Botticelli, Project Director, National Science Teachers Association, Washington, D.C., pp. 38-43.

Cutler, Janice A. "Heat and Temperature," Science and Children, Vol. 3, No. 3, (November, 1968), pp. 36-42. The author discusses some of the concepts found in COPES project unit.

Hill, Katherine E. "Science in the Elementary School: A Look Ahead," Science and Children, Vol. 6, No. 5, (January-February, 1969), NSTA, Silver Review. The author raises several questions regarding the future of science teaching and makes some predictions.

"International Chemical Education: The High School Year," Proceedings of a conference held August 28 to September 2, 1967, Washington, D.C., O. Theodore Benfey and Saul L. Geffner, Eds., American Chemical Society, Washington, D.C. 1968, p. 96.

Lockard, J. David, Compiler. "Conceptually Oriented Program in Elementary Science," Report of the International Clearinghouse on Science and Mathematics Curricular Developments (see first entry in General section), 1967, pp. 203-204. Program makes use of the "spiral" approach in presenting concepts of the major conceptual schemes for grades K-6.

Lockard, J. David, Compiler. "Conceptually Oriented Program for Elementary Science," Sixth Report of the International Clearinghouse on Science and Mathematics Curricular Developments (see first entry in general section), 1968, pp. 197-199. A brief description of activities since the 1967 report.

Lockard, J. David, Compiler. "Conceptually Oriented Program for Elementary Science," Sixth Report of the International Clearinghouse on Science and Mathematics Curricular Developments (see first entry in general section), 1968, pp. 229.

"NYU and Kids," Science Digest, February, 1967, pp. 26-17.

"Scientific Literacy: The COPES Approach," The Indicator, ("Chemical Education Today"), New York and New Jersey American Chemical Society News, Vol. 50, No. 1, (January, 1969), pp. 26, 28-30.

Shamos, Morris H. "COPES, A New Elementary Science Approach," Scholastic Teacher, Vol. 30, No. 7, (March 17, 1967), p. 9.

Shamos, Morris H. "The Role of Major Conceptual Schemes in Science Education," The Science Teacher, Vol. 33, (January, 1966), pp. 27-30. A discussion of conceptual schemes in curriculum development by the Director of COPES.

Victor, Edward. "Controversial Aspects of the Elementary Science Curriculum Projects," Science and Children, Vol. 5, No. 2, (October, 1967), pp. 27-30. Questions are raised concerning the processes, structure and evaluation of the recently developed science curriculum projects.

Educational Services, Inc.

ELEMENTARY SCIENCE STUDY

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Buck, Ruth Moss. "The New Science," The Chicago Tribune, (November 24, 1963), A newspaper article on the Elementary Science Study of Education Services, Inc. Descriptive of activities.

Bennett, Lloyd M. "Experimenting with an ESS Unit--Growing Seeds in a Demonstration School Kindergarten Class," School Science and Mathematics, Vol. 64, No. 5, (May, 1969), pp. 367-373. The unit, "Growing Seeds," was used in a program involving pre-school children and teachers-in-training.

Cunningham, John D. "New Developments in Elementary School Biology," The American Biology Teacher, Vol. 28, No. 3, (March, 1966), pp. 193-198. Gives a brief description of the role of the SCIS, ESS, AAAS, and ESSP programs in teaching biology in the elementary school.

Cunningham, John D. "Elementary School Biology Revisited," Science Education, Vol. 52, No. 2, (March, 1968), pp. 181-189. A survey of the biological element in current elementary school science projects. Programs surveyed include SCIS, ESS, AAAS, Minnemast, SSCP (Ill.), ESSP (U. of Cal.), ESSP (Utah), African Primary Science Program, and others.

Duckworth, Eleanor. "ESSP of ESI," Journal of Research in Science Teaching, Vol. 2, (September, 1964), pp. 241-243. Reviews efforts of Educational Services, Inc.

Duckworth, Eleanor. "Liquid Layer Cakes," Nature and Science, Vol. 1, (October 4, 1963). Brief description of one of the Elementary Science Study unit ideas.

Finley, Gilbert. "The Elementary Science Study," Elementary School Science Bulletin, No. 76, (February, 1963), p. 3. An explanatory article about Elementary Science Study. A small amount of material on philosophy and a description of the 1962 summer study.

Gardner, Robert. "How Much Does Air Weigh?" Science and Children, Vol. 5, (May, 1968), pp. 14-15. An ESS unit developed for sixth grade. With the use of simple homemade apparatus, children investigate properties of air, comparing its weight with carbon dioxide.

Grade Teacher, Vol. 83, (January, 1966), p. 59 Outlines theory and techniques and ten representative exercises from the project.

Hawkins, David. "Highlights of the 1963 Elementary Science Study Summer Conference," Education Services, Inc., 108 Water Street, Watertown, Mass. 02172.

Hawkins, David. "Laboratory Science in Elementary Schools," American Journal of Physics, Vol. 32, (November, 1964), pp. 839-842. Brief description of gaining understanding with children of science principles; stresses active involvement with manipulative devices.

Hawkins, David. "Messing About in Science," Science and Children, Vol. 2, (February, 1965), pp. 5-9. Author points out three phases in elementary science teaching. Starting with the "messing" around phase through the more formal presentation.

Hawkins, David. "The Stuff from Which Questions Are Shaped," Nature and Science, Vol. 1, (April 17, 1964), p. 16. Discussion of manipulative devices that involve children. A study of a phenomena that will arouse an enjoyment that will lead to questioning of the environment.

Hawkins, David. "The Informed Vision: An Essay on Science Education," Daedlus, Summer, 1965, pp. 538-552. Argues for the importance of science in childhood education not merely for technology, but as a condition of "being at home" in a modern world. The author, therefore, emphasizes the analogy of art, and the importance of esthetic involvement with the concrete phenomena of field and laboratory - as opposed to current pre-occupation with "concepts" and "principles."

Hawkins, David. "On Chance and Choice," Reviews of Modern Physics, Vol. 36, No. 2, (April, 1964).

Labinowich, Ed. "A Closer Look at Environmental Education," Science and Children, Vol. 8, No. 6, (March, 1971), pp. 31-35. Suggests that several of the independent ESS units which relate to the biological world could supplement other programs which deal exclusively with conservation ideas and resources.

Lagemann, John Kord. "A New Way for Children to Learn," Redbook, Vol. 122, (February, 1964), pp. 42-43, 107-110. Points out basic philosophy of Elementary Science Study with rationale of the new program.

Lapp, Douglas M. and Benton, Leslie J. "Supporting an Elementary Science Program Through Community Industry," Science and Children, (March, 1974), pp. 11-13. Fairfax City, Virginia - implementation and training for use of ESS in communities.

Lockard, J. David, Compiler, "Elementary Science Study (Nichols)," Third Report of the Information Clearinghouse (see first entry under general section), p. 24. A complete report on the project through March, 1965, with lists of publications to date, availability, and future plans.

Lockard, J. David, Compiler. "Elementary Science Study," Report of the International Clearinghouse on Science and Mathematics Curricular Developments (see first entry under general section), 1967, pp. 224-242. Detailed description of 77 ESS units, also gives a summary of activities since the 1966 report and plans for the future.

Lockard, J. David, Editor. "Elementary Science Study," Sixth Report of the International Clearinghouse on Science and Mathematics Curricular Developments (see first entry under general section), 1968, pp. 22-232. A progress report on the 48 units and reports on evaluation and in-service activities during 1967.

Lockard, J. David, Editor. "Elementary Science Study," Seventh Report of the International Clearinghouse on Science and Mathematics Curricular Developments (see first entry under general section), 1970, pp. 225, 369-383.

Morrison, Philip and Walcott, Charles. "Enlightened Opportunism," Journal of Research in Science Teaching, Vol. 1, (1963), pp. 48-53. An informal account of the Elementary Science Study of 1962.

Morrison, Philip. "Experimenters in the School Room," Science, Vol. 138, (December 21, 1962), pp. 1307-1310. A description of early work of Elementary Science Study stressing laboratory procedures. "Research scientists and imaginative teachers join to construct a new program in science for primary schools."

National Science Foundation. "Elementary Science Study," Science Course Improvement Projects, (July, 1964), p. 12, Washington: U.S. Government Printing Office. A brief description of the project by David Hawkins.

Nicodemus, Robert B. "Content and Skill Hierarchies in Elementary Science: An Analysis of ESS Small Things," Journal of Research in Science Teaching, 7: ;73-177, 1970. A unit from ESS is analyzed using the SAPA model of sequential development.

Nichols, Benjamin. "Enjoy Teaching Elementary Science," Instructor, Vol. 75, (January, 1966), pp. 91-92. Dr. Nichols discusses basic philosophy of the experimental programs. Emphasizes the involvement of children and pacing from first hand experiences.

Nichols, Benjamin. "ESS--Two Years Later," Journal of Research in Science Teaching, Vol. 2, (December, 1964), pp. 288-292. After several years of development Elementary Science Study is offering some samples of its work to a wider public. Much work still needs to be done in order to turn elementary classrooms into individual exploratory centers.

Nichols, Mary V. "Show Me Science Learning by Experiment," Cornell Alumni News, Ithaca, New York, (January, 1964). A description of the Elementary Science Study philosophy involving "doing" by children.

Newport, J. "It's Time for a Change," School Science and Math, Vol. 65, (November, 1965), pp. 725-728 (see AAAS).

Richard, Emily L. "Ideas Unlimited for Child Scientists," Wellesley Alumnae Magazine, (January, 1965). Brief historical presentation of Elementary Science Study and a subsequest description of the type of work carried on.

Rice, Michael. "Fooling Around with Water," Science and Children, Vol. 7, No. 4, (December, 1969), pp. 16-19. Four styles of work observed while the unit, Water Flow, was being developed by the ESS. A fifth grade experiment.

Rogers, Robert E. and Voelker, Alan M. "Programs for Improving Science Instruction in the Elementary School, ESS," Science and Children, Vol. 7, No. 5, (January-February, 1970), pp. 35-43. Article provides an overall description of the ESS program based on ERIC bibliography. It covers the nature of the program, instructional materials, use of materials, implementation and teacher programs, evaluation and the role of the teacher.

Schlenker, George C. "'Sciencing' in the Elementary School," Science and Children, science teaching is laboratory work, activity which encourages investigation and discovery - which permits children to practice 'sciencing.'"

"Science Round-Up," Scholastic Teacher, (November 11, 1965), p. 3. Announcement of the NSF continuing support of ESS.

Simpson, R.D. "Comparison of Biologic Content in Three Elementary School Science Curriculum Projects; ESS, S-APA, SCIS," American Biology Teacher, Vol. 36, (May, 1974), pp. 340-343.

Singer, Phyllis. "Shadows and Holes," Nature and Science, Vol. 1, (May 1, 1964), p. 14. Workshop type activity with suggestions for studying shadows. Emphasizes pupil involvement.

Sizer, Theodore, "Curriculum Reform: Snags and Pitfalls," Education Summary, Vol. 18, (November 15, 1965), p. 5. Analysis of current ESI quarterly report is summarized. Purpose of ESI is outlined and reasons are given why it is one of the most influential leaders in curriculum reform.

Stocking, S. "Reply and Rejoinder to Comparison of Biologic Content in Three Elementary School Science Curriculum Projects; ESS, S-APA, SCIS." American Biology Teacher, Vol. 97, (February, 1975), pp. 119-120. Letter and answer about November, 1974 article-an extent of implementation and amount of and extent of sequential development through the grades (of the programs).

Walcott, Charles. "Biology in the Elementary School," National Association of Biology Teachers News, Vol. VII, (April, 1963). A brief report of a third grade class working with an experimental unit in entomology. Presents also several reasons for studying biology in the elementary school. Child involvement.

Walcott, Charles. "Elementary Science Study," Science Education News, (December, 1962), AAAS Misc. Publication 62-14. A brief discussion of the initial work of the Elementary Science Study in Watertown, Massachusetts.

Walcott, Charles. "Elementary School Biology," The American Biology Teacher, Vol. 29, (March, 1967), pp. 180-184. Discussion of the purpose and theory of the ESS program. Concrete examples are given as to how the theory applies to real life situations.

Wailes, James R. "Science Innovations," The National Elementary Principal, Vol. XLIII, (September, 1963), pp. 25-26. A discussion of general information and specific detail on three programs including the Elementary Science Study of Educational Services, Inc.

Waisik, John L. and Nicodemus, Robert B. "A Study of the Effects of a Workshop and Use of Specially Developed Science Materials on Fifth Grade Science Classroom Practices," Science Education, Vol. 53, No. 4, (October, 1969), pp. 347-355. The study, based on the ESS unit "Small Things," discusses the effect of inservice workshops on science teaching techniques.

Webster, David. "How to Help Children Make Mistakes," Science and Children, Vol. 1, (May, 1964), pp. 13-14. Description of an Elementary Science Study unit that develops an experiment with ample opportunity for mistakes; "most significant form of learning comes from process of making a mistake, realizing it and then attempting to correct it."

Webster, David. "Making a Chicken Skeleton," Nature and Science, Vol. 1, (May 1, 1964), p. 3. Several class activities to help children understand the functions of various parts of a skeleton. Emphasis on child involvement.

Werner, Ben. "Parallel Evolution of Elementary Science Programs in Great Britain, Japan, and the United States." Science and Children, (December, 1972), pp. 20-21. Comparison of philosophy, methodology and content of Nuffield, 5-13, ESS, SCIS, Japanese Elementary Science Curriculum.

Wittlin, Alma S. "Scientific Literacy Begins in the Elementary School," Science Education, Vol. 47, (October, 1963), p. 331. Suggests a course of action to achieve literacy in science.

Zacharias, Jerrold R. "Learning by Teaching," Instructor, Vol. 75, (January, 1966) p. 23ff. Author proposes a large number of universities and colleges, high schools and elementary schools work together to devise experiments in learning by teaching. Stresses need for a large variety of attempts.

Zacharias, Jerrold R. "What's Ahead in Elementary Science," The Instructor, Vol. 76, No. 5, (January, 1967), pp. 16-17. A vice president of ESI gives his ideas of what elementary science should be with an interesting illustration from the program in Africa.

Zimmerman, Marianna. "The Inconstant Moon," Science and Children, Vol. 7, No. 7, (April, 1970), pp. 26-32. A complete unit of study on the moon and the teaching method applied by the author to a sixth grade class. The ESS project used was Astronomy: Charting the Universe.

University of California

ELEMENTARY SCHOOL SCIENCE PROJECT

Funded by the National Science Foundation

ESSP, University of California
2232 Piedmont Avenue
Berkley, California 94720

Brown, Stanley B. "Comparative Embryology at Second Grade," The American Biology Teacher, Vol. 29, No. 3 (March, 1967), pp. 200-207. The unit "What Am I?" developed by the ESSP at Berkeley, California, is the basis for this interesting unit comparing the development of human and chick embryos.

Cunningham, John D. "Elementary School Biology Revisited," Science Education, Vol. 52, No. 2 (March, 1968), pp. 181-189. A survey of the biological element in current elementary school science projects, including ESSP.

Ipsen, Davis. "Elementary School Science Project," Science Education News, (December, 1961). A progress report of the ESSP to this date.

Ipsen, David. "Elementary School Science Project," Science Education News, (December, 1962), AAAS Misc. Pub. 62-14. A brief report of the efforts of this group at the University of California.

Lockard, J. David, Compiler. "University of California Elementary School Science Project (Mason," Third Report of Information Clearinghouse (see first entry under general section), 1965, p.64. A complete report on the project through March, 1965, with lists of publications, availability, and future plans. ESSP California pp. 253.

Lowery, Lawrence F. "An Experimental Investigation into the Attitudes of Fifth Grade Students Toward Science," School Science and Mathematics, Vol. 67 (June, 1967), pp. 569-579. The report of a research study involving a unit from ESSP.

Mason, Herbert L. "The Elementary School Science Project," New Developments in Elementary School Science: A Conference, Frontiers of Science Foundation of Oklahoma, Inc. (February 27, 1964), pp. 44-49. A paper on the progress of the project.

National Science Foundation. "Elementary School Science Projects," Science Course Improvement Projects (July, 1964), pp. 10-11, Washington: U.S. Government Printing Office. A short description of the project.

National Science Foundation. "Elementary School Science Project," Course and Curricular Improvement Projects (September, 1966), p.7, Washington: U.S. Government Printing Office. Units and available materials are listed.

Scott, Lloyd F. "An Experiment in Teaching Basic Science in the Elementary School," Science Education, Vol. 46 (March, 1962), p. 105. Report on the early work of the ESSP at the University of California in experimenting with elementary science curricula.

Scott, Lloyd. "Research Scientists Build an Elementary School Science Program," Elementary School Science Bulletin, No. 66 (December, 1961), pp. 1-3. Brief description of early work on units of the ESSP at the University of California.

Scott, Lloyd. "Science is for the Senses," Science and Children, Vol. 2 (March, 1965), pp. 19-22. Sequential program devised for the improvement of experimentation and active participation of children in the fields of science. Draws from all fields of science.

Scott, Lloyd F. "The University of California Elementary School Science Project: A 2-Year Report," Science Education, Vol. 46 (March, 1962), p. 109. This article deals with the evaluations of the instructional materials developed

Scott, Lloyd, "The University of California Elementary School Science Project: A 2-Year Report," Science Education, Vol. 46 (March, 1962), p. 105. Report of the ESSP presented at American Educational Research Association meeting.

Scott, Lloyd. "UCESSP: An Experiment in Diversity," Journal of Research in Science Teaching, Vol. 2 (December, 1964), pp. 364-370. Explains the unique characteristics of the California project. (21 professors involved, curriculum experimentation, no limit placed on areas to receive attention.)

Wailes, James R. "Science Innovations," The National Elementary Principal, Vol. 43 (September, 1963), pp. 24-25. A discussion of general information and specific information on three programs: Elementary Science Study, Elementary School Science Project (Illinois) and Elementary School Science Project (California).

University of Illinois

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ESSP, University of Illinois
805 West Pennsylvania Avenue
Urbana, Illinois 61801

Atkin, J. M. and Karplus, Robert. "Discovery or Invention," The Science Teacher, Vol. 29 (1962), p. 45. A description of several experiments devised for children to discover concepts. Discusses the role of the teacher.

Atkin, J. M. "The University of Illinois Elementary School Science Project," Elementary School Science Bulletin, Vol. 66 (1961). Brief description of work of Elementary School Science Project in astronomy at the University of Illinois.

Atkin, J. Myron. "The Elementary School Science Curriculum," The Science Teacher, Vol. 27 (Mar. 1960), pp. 51-54. Historical developments leading to modern curricular revision in the elementary school science field. Emphasis on the University of Illinois program.

Atkin, J. M. "Teaching Concepts of Modern Astronomy to Elementary School Children," Science Education, Vol. 45 (February, 1961), p. 54. Paper represents an early phase of a research program at the University of Illinois on the development of curricular materials utilizing astronomy.

Atkin, J. Myron. "University of Illinois ESSP," Journal of Research in Science Teaching, Vol. 2 (December, 1964), pp. 328-329. Mentions the development of six books on astronomy, grades 5-8 (written during summer of 1964).

Froehlich, K. P. Explicit expression of objectives in testing. Journal of Research in Science Teaching, Vol. 11, #4 (1974), pp. 371-376. Examining effects of writing objectives with test items (using unit "The Message of Starlight" ESSP) in pretest (helpful) and protest (hinderance) situations.

Klopfer, Leopold E. "Effectiveness and Effects of ESSP Astronomy Materials--An Illustrative Study of Evaluation in a Curriculum Development Project," Journal of Research in Science Teaching, Vol. 6, (1969), pp. 64-75. A study to investigate the effectiveness of the ESSP materials in increasing students' knowledge and of how astronomy information is obtained. No control groups were involved.

Lockard, J. David, Compiler. "University of Illinois Elementary Science Project (Atkin-Myatt)," Third Report on Information Clearinghouse (see first entry under general section), 1965, p. 71. A complete report on the project through March, 1965, with lists of publications, availability, and future plans.

Lockard, J. David, Compiler. "Elementary School Science Project (ESSP)," Report of the International Clearinghouse on Science and Mathematics Curricular Developments (see first entry under general section), 1967 pp. 214-215. Contains a list of materials available; summarizes evaluation activities and plans for the future.

Lockard, J. David. "Elementary School Science Project (Astronomy)," Sixth Report of the International Clearinghouse on Science and Mathematics Curricular Developments (see first entry under general section), 1968, pp. 218-219. A brief summary of the project to date, including objectives, materials produced, implementation, and evaluation.

Lockard, J. David, Editor. "Elementary School Science Project," Seventh Report of the International Clearinghouse on Science and Mathematics Curricular Developments (see first entry under general section), 1970, p. 596, 388. Reports the project is inactive but provides an address for information.

National Science Foundation. "Elementary Science Study," Science Course Improvement Projects, July, 1964, p. 11, Washington: U.S. Government Printing Office. The project is briefly described.

National Science Foundation. "Elementary School Science Project," Course and Curriculum Improvement Projects (September, 1966), p. 8, Washington: U.S. Government Printing Office. Guiding principles of the project; work being done; materials available.

Newport, John F. "A Look at the University of Illinois Astronomy Materials," School Science and Math, Vol. 65 (February, 1965), pp. 145-147. Mr. Newport points out that materials (math and science) are integrated, are readable, and refreshing in approach and material is simply presented.

Pierce, Gail. "Report of the 1963 Writing Conference," Journal of Research in Science Teaching, Vol. 1 (1963). Progress report of Illinois project.

Stecher, Joann. "Astronomy for Grades Five Through Eight," Science and Children, Vol. 2 (February, 1965), pp. 23-24. Sequential study of astronomy. Emphasis on a few ideas rather than many loosely connected facts. Books deal with basic aspects of astronomy and attempt to assist student in perceiving the basic structure of the subject.

Sutton, R. M. "Astronomy: Charting the Universe p. 78, The Universe in Motion p. 94, Gravitation, p. 94," The Physics Teacher, Vol. 3 (February, 1965) p. 82. Mr. Sutton gives a review of these three paper-back books issued by Elementary School Science Project, Illinois.

"The Necessary Nine," Grade Teacher, Vol. 85, No. 5 (January, 1968), pp. 87-90. Elementary science curriculum revision projects which teachers should be familiar with.

Wailes, James R. "Science Innovations," The National Elementary Principal, Vol. 43 (September, 1963), pp. 26-27. A discussion of general information and specific detail on three programs: Elementary Science Study, Elementary School Science Project (Illinois), and Elementary School Science Project (California).

Wyatt, Stanley. "Elementary School Science Project," Science Education News, December, 1961. A progress report.

Wyatt, Stanley. "University of Illinois Elementary Science Project," Science Education News (December, 1962), AAAS Misc. Pub. 62-14. Describes the project and its progress from inception to December, 1962.

National Science Foundation. "Elementary School Science Project," Science Course Improvement Projects (see second entry under general section), p. 11. A brief report on the project designed to utilize astronomy in the grades 5-8 curriculum.

Utah State University

ELEMENTARY SCHOOL SCIENCE PROJECT

Funded by the National Science Foundation

ESSP, Utah State University
Department of Physics
Utah State University
Logan, Utah 84321

Braswell, A. L. "Science for the First Grade," Science and Children, Vol. 2 (February, 1965), pp. 10-11. Content comes from all areas of science and the skills of observation and development of the use of the senses is stressed. Discovery being emphasized.

Cunningham, Robert D. "Elementary School Biology Revisited," Science Education, Vol. 52, No. 2 (March, 1968), pp. 181-189. A survey of the biological element in current elementary school science projects.

Lockard, J. David, Compiler. "Elementary School Science Project (Wood)," Third Report of the Information Clearinghouse (see first entry under general section), 1965, p. 22. A complete report on the project for grades 1 and 2.

Lockard, J. David, Compiler. "Elementary School Science Project (ESSP)," Report of the International Clearinghouse on Science and Mathematics (see first entry under general section), 1967, pp. 214-216, 254. A complete up-to date report on the project.

National Science Foundation. "Elementary School Science Improvement Project," Science Course Improvement Projects (July, 1964), pp. 14. Washington: U.S. Government Printing Office. A brief report on the project concerning a series of lessons for grades 1 and 2.

Wood, J. K. "A Science Program for the Elementary Grades," Journal of Research in Science Teaching, Vol. 2, No. 4 (December, 1964), pp. 323-327. This article reviews the first grade program in science at Utah State University. Also gives a second grade teacher's guide.

Wood, J. K. "Elementary Science in the First Grade," American Journal of Physics, Vol. 32 (November, 1964), pp. 830-831. A description of several experiments carried out with six and seven year olds in the physics area. Description of an approach in the Utah State University program.

University of Minnesota

MINNESOTA MATHEMATICS AND SCIENCE TEACHING PROJECT (MINNEMAST)

Funded by the National Science Foundation

Minnesota School Mathematics and Science Center
Second Floor, TSCE
University of Minnesoaa
Minneapolis, Minnesota 55455

Quarterly MINNEMAST reports available by writing project headquarters.

Ahrens, Robert B. "Minnemast, The Cooodinated Science and Math Program," Science and Children, Vol. 2 (February, 1965), pp. 16-18. Program devised to establish a coordinated math and science program (K-9). The program is keyed to the operations in science.

Bray, Edmund C. "Minnemast, " School Science and Mathematics, Vol. 64, No. 6 (June, 1969), pp. 541-547. A description and progress report of the project.

Bray, Edmund C. "The Minnemast Elementary Mathematics--Science Program," The Physics Teacher, Vol. 6, No. 5 (May, 1968), pp. 201-206. This article describes the manner in which the project materials are developed.

Bursheim, J. M. and Reed, E. W. "Classroom testing: indispensible for curriculum development: MINNEMAST unit, conditions affecting life." Science and Child Vol. 10 (October 1972) pp. 9-11. Discussion of testing unit.

Cohn, Angelo, Editor. Minnemath Center Reports, Minnesota School Mathematics and Science Center, Institute of Technology, University of Minnesota, Minneapolis, Minnesota 55455. Published quarterly by the center. Many relevant articles to project in the reports.

Cunningham, John D. "Elementary School Biology Revisited," Science Education, Vol. 52, No. 2 (March, 1968), pp. 181-189. A survey of the biological element in current elementary school science projects, including MINNEMAST.

Karplus, Robert. "Minnemast Science Writing Conference--Summer, 1963," Minnesota Journal of Science, Vol. 7 (December, 1963), pp. 10-16. Summarizes the work of Minnemast projects carried on by 35 educators at the conference.

Kullman, David E. "Correlation of Mathematics and Science Teaching," School Science and Mathematics, Vol. 66 (October, 1966), pp. 645-648. Pros and cons of interrelating math and science in the classroom.

Lockard, J. David, Compiler. "Minnesota Mathematics and Science Teaching Project (Rosenbloom-Herntz)," Third Report of the Information Clearinghouse (see first entry in general section), 1965, p. 39. A complete report on the project through March, 1965 with list of publications, availability and future plans.

Lockard, J. David, Compiler. "Minnesota Mathematics and Science Teaching Project (Minnemast), " Sixth Report of the International Clearinghouse on Science and Mathematics Curricular Developments (see first entry in general section), 1968, pp. 286-288. Lists units already produced. Describes the progress in implementation and evaluation. Plans for the future include developments of curriculum materials for grades 3-6.

Lockard, J. David, Compiler. "Minnesota Mathematics and Science Teaching Project (Minnemast)," Report of the International Clearinghouse on Science and Mathematics Curricular Developments (see first entry in general section), 1967, pp. 284-285. Lists materials produced. Present emphasis is on evaluation of materials and the development of in-service materials for teachers.

Lockard, J. David, Editor. "Minnesota Mathematics and Science Teaching Project (Minnemast)," Seventh Report of the International Clearinghouse on Science and Mathematics Curricular Developments (see first entry in general section), 1970, pp. 328, 461-455. Provides an up-to-date report and lists several papers on evaluation.

Murray, F. B. "Note on using curriculum models to analyze the child's concept of weight." Journal of Research in Science Teaching Vol. 7 No. 4 (1970) 377-381. Suggestions for use of curriculum models (specifically used here was "MINNEMAST) to teach laws and concepts of physical science.

National Science Foundation. "Minnesota School Mathematics and Science Teaching Project (Minnemast)," Science Course Improvement Projects (July, 1964), p. 3. A brief description of the project.

Rising, Gerald R. "Recommendations for the Preparation of Elementary Teachers in Science," Science Education, Vol. 49 (October, 1965), pp. 359-362. From background in working with Minnemast program makes recommendation relative to content and elective methods courses.

Rising, Gerald. "Research and Development in Mathematics and Science Education at the Minnesota School Mathematics and Science Center and the Minnesota National Laboratory," School Science and Mathematics, Vol. 65 (December, 1965), pp. 811-814. Outlines goals, development of materials of program and their introduction into the classroom.

Rosenbloom, P. C. "A Leap Ahead in School Mathematics," Countdown for Elementary Schools, Frontiers of Science Foundation of Oklahoma, Inc., 1959, pp. 24-31. A sketch of a coordinated science and math program for elementary schools.

Rosenbloom, P. C. "Minnemast Project," Journal of Research in Science Teaching, Vol. 1 (September, 1963), pp. 276-280. This article outlines recent activities of this project; it is the only major effort at the present time whose primary goal is the production of a coordinated science and math curriculum for grades K-9.

Rosenbloom, P. C. "National Conference in Curriculum Experimentation," School and Society, Vol. 89 (December 16, 1961), pp. 436-437. Short presentation of a national conference for major curriculum groups held at the University of Minnesota.

Rosenbloom, P. C. "Large Scale Experimentation with Mathematics Curriculum," Second Annual Phi Delta Kappa Symposium on Educational Research, 1961, pp. 11-43. Description of research procedures at University of Minnesota in developing a math-science curriculum. Questions and answers included.

Rosenbloom, P. C. "Mathematics K-14," Educational Leadership, Vol. 19 (March, 1962), pp. 359-363. Brief presentation of the idea behind the K-14 program of Minnemast program.

Rosenbloom, P. C. "What is Coming in Elementary Mathematics," Educational Leadership, Vol. 18 (November, 1960), pp. 96-100. Author discusses briefly specific changes that have developed in recent years.

Subarsky, Zachariah. "First Grade Chemistry," Science and Children, Vol. 4 (December, 1966), pp. 5-7. Using mostly disposable apparatus made from simple household materials, children investigate the properties of gases and other chemical phenomena.

Subarsky, Zachariah, "The Systems Concept," The Instructor, Vol. 77, No. 5 (Jan., 1968), pp. 82-91. The author, a staff member of the MINNEMAST project, helps you to understand this important concept of a system developed for teaching purposes.

"The Necessary Nine," Grade Teacher, Vol. 85, No. 5 (January, 1968), pp. 87-90. Elementary science curriculum projects which the author feels teachers should be familiar with. Each suggests practical ways to improve a curriculum.

Victor, Laurence J. "The Conceptual Schemes of Science," Science Education, Vol. 53, No. 4 (October, 1969), pp. 335-339. Curriculum developers for the Minnemast program discuss the importance of understanding the "conceptual schemes of science" i.e., the nature of objects and events, systems, space and time, etc.

Victor, Laurence J. "The Development of Modern Space-Time Concepts in the Elementary School," Journal of Research in Science Teaching, 6: 36-41, 1969. A useful discussion on the teaching of the relational concepts of space and time to elementary school children.

University of California

SCIENCE CURRICULUM IMPROVEMENT STUDY

Funded by the National Science Foundation

SCIS, Lawrence Hall of Science
University of California
Berkeley, California 94720

Rand McNally & Company
Customer Service Dept.
P.O. Box 7600
Chicago, Illinois 60680

Newsletters and some reprints available from project office.

Atkin, J. M. and Karplus, R. "Discovery of Invention," The Science Teacher, Vol. 29, (September, 1962), p. 45. A description of several experiments devised for children to discover concepts. Discusses the role of the teachers.

Allen, Leslie R. "An Evaluation of Certain Cognitive Aspects of the Material Objects Unit of the Science Curriculum Improvement Study Elementary Science Program," Journal of Research in Science Teaching, Vol. 7, No. 4 (1970), pp. 277-281. A comparison of SCIS and non-SCIS grade I students on certain SCIS objectives.

Allen, L. R. "Evaluation of children's performance on certain cognitive, affective and motivational aspects of the interaction unit of the Science curriculum improvement study elementary science program. Journal of Research in Science Teaching, Vol. 3 No. 2 (1972) pp. 167-173. Second grade evaluation study shows children using SCIS are statistically superior to non-SCIS children in both cognitive affective behavior categories.

Allen, L. R. "Evaluation of children's performance on certain cognitive, affective and motivational aspects of the systems and sub-systems unit of Science Curriculum Improvement Study elementary science program. Journal of Research in Science Teaching, Vol. 10, No. 2 (1973) pp. 125-134. Study shows that "Honolulu third grade SCIS children are statistically superior to non-SCIS children in both cognitive and motivated (explanatory) behavior.

Allen, L. R. "Examination of the ability of first graders from the Science Curriculum Improvement Study program to describe an object by its properties. Science Education, Vol. 55 (Jan. 1971) pp. 61-67. First grade study of SCIS children show some degree of superiority over non-SCIS children in reference to concepts of material objects.

Allen, L. R. "Examination of the ability of third grade children from the Science Curriculum experimental study to identify experimental variables and to recognize change. Science Education Vol. 57 (April 1973) pp. 135-151. Third grade SCIS children appear superior to non-SCIS children both in their ability to identify experiental variables and to recognize change.

Beisenherz, P. C. "Comparison of the quality and sequence of television and classroom science questions with a proposed strategy of science instruction." Journal of Research in Science Teaching, Vol. 10, No. 4 (1972) pp. 355-363. Differences in questioning behavior are found between TV and non-TV treatment groups that utilized a SCIS strategy of science instructor.

Brown, T. W. et al "Research on the development of scientific literacy." Science and Children Vol. 12 (Jan. 1975) pp. 13-15. Relates research and report of study which concludes that SCIS trained children develop positive attitudes towards science and a 6th grade SCIS group was not significantly different from practicing scientists in their attitudes towards science and scientists.

Bruce, R. "Study of the relationship between the SCIS teachers' attitude toward the teacher-student relationship and question types." Journal of Research in Science Teaching, Vol. 8, No. 2 (1971) pp. 157-164. A review of literature and study to indicate that the "teacher's question-asking behavior and attitude toward student-teacher relationship is important" and that "use of SCIS materials may cause the teacher to ask higher level questions."

Cunningham, John D. "A Study of Children's Perceptual Rigidity," Journal of Experimental Child Psychology.

Cunningham, J. D. "The Einstellung Phenomena in Children," Journal of Experimental Child Psychology, Vol. 2, (1965), pp. 237-247.

Cunningham, John and Karplus, Robert. "The Free Fall Demonstration Experiment," American Journal of Physics, Vol. 30, (September, 1962), p. 656. Work with seven to twelve year old students described in a demonstration experiment.

Cunningham, John D. "New Developments in Elemenaary School Biology," The American Biology Teacher, Vol. 28, No. 3 (March, 1966), pp. 193-198. Gives brief description of the role of the SCIS, ESS, AAAS, and ESSP programs in teaching biology in the elementary school.

Cunningham, John D. "Elementary School Biology Revisited," Science Education, Vol. 52, No. 2, (March, 1968),pp. 181-189. A survey of the biological element in current elementary school science projects. Programs surveyed in considerable detail include SCIS, ESS, AAAS, Minnemast, SSCP (Ill.), ESSP (U. of Cal.), ESSP (Utah), African Primary, and others.

Davis, Jospeh E., Jr. "Ice Calorimetry in the Upper Elementary Grades," Science and Children, Vol. 4, (December, 1966), pp. 13-15. Fourth grade children gain concepts of energy through activities which investigate melting ice cubes.

Fischler, Abraham S. and Lewis, Robert B. "The Concept of a Learning System," Science and Children, Vol. 2, (October, 1964), pp. 17-19. Article deals with a newly developed system devised to enable teachers to utilize all things currently available in science. A living ecosystem is used as the example in the article.

Fischler, A. and Anastasiow, N. "School Within a School," Journal of Research in Science Teaching, Vol. 3, (1965), pp. 280-285. A method of improving science teaching. Utilized SCIS materials and the discovery approach.

Fishleder, J. "Science Curriculum Improvement Study" American Biology Teacher (Oct. 1973) pp. 389-391. History of program and its importance in environmental education.

Garigliano, L. J. "SCIS children's understanding of the systems concept. School Science and Math (March 1975) 75: 245-250. Testing of and discussion of children's understanding of systems concept (found to be lower than expected in SCIS schools).

George, K. D. and Dierg, M. A. "Inner city child: an attempt to improve his science problem solving skills" Science Education (Oct. 1971) 55: 527-532. Using the material object unit the study shows that inner city children show greater ability in problem solving skills than norm group.

Jones, Kenneth W. "Explore, Invent, and Discover with Seltzer Tablets." Science Education, Vol. 54, No. 3, (1970), pp. 241-242. The short article provides an example of using the three steps of SCIS - exploration, invention, and discovery.

Karplus, R. "Beginning a Study in Elementary School Science," American Journal of Physics, Vol. 30,(January, 1962), pp. 109. Description of the work of several scientists and educators in studying problems of science teaching in the elementary school during the first year of the project.

Karplus, Robert. "Chemical Phenomena in Elementary School Science," Paper American Chemical Society, April, 1965, Detroit, Michigan.

Karplus, Robert. "The Science Curriculum: One Approach," Elementary School Journal Vol. 62, (1962), p. 243.

Karplus, Robert and Powell, Cynthia Ann. "Objects Grab Bag," Science and Children, Vol. 1, (October, 1963), pp. 14-15. This article deals with a game that the two authors developed. Provides a situation whereby children's ability to count is improved and critical observation is improved.

Karplus, Robert. "One Physicist Experiments with Science Education," American Journal of Physics, Vol. 32, (November, 1964), pp. 837-839. A brief description of SCIS--experimentation with science teaching.

Karplus, Robert. "Meet Mr. O." Science and Children, Vol. 1, (November, 1963), pp. 19-24. Describes the use of "Mr. O," an artificial observer, to gain an understanding of the relationships of objects in a system.

Karplus, Robert. "Science Curriculum Improvement Study," Science Education News, December, 1962, AAAS Misc. Pub., 62-14. A brief presentation of the plans of the SCIS group.

Karplus, Robert. "Science in the Elementary School," New Developments in Elementary School Science: A Conference, Frontiers of Science Foundation of Oklahoma, Inc., February 27, 1964, pp. 1-13. A progress report of the program from its inception through plans for 1964

Karplus, Robert. "SCIS Report to Piaget Conference," Journal of Research in Science Teaching, Vol. 2, (September, 1964), pp. 236-240. This is a short description of the work of SCIS.

Karplus, R. "Science Curriculum Improvement Study," Journal of Research in Science Teaching, Vol. 2, (December, 1964), pp. 293-303. Mr. Karplus' article reviews: why Elementary School Science? The Curriculum Plan, The Teaching Experience; also gives typical responses to K-3 grade students in classrooms he has observed.

Karplus, Robert and Thier, H. D. "Science Curriculum Improvement Study," The Instructor, Vol. 74, (January, 1965), pp. 43-84. A comprehensive treatment of the various units worked out by the SCIS project at the University of California.

Karplus, Robert. Theoretical Background of the Science Curriculum Improvement Study, SCIS, University of California, Tolman Hall, Berkeley, California 94720. Discusses the general strategy of the study.

Karplus, Robert. "Teaching Physics in the Elementary Grades," Physics Today, Vol. 17, (October, 1964), pp. 34-38. The report of a symposia on the various programs. Karplus discusses each one briefly. Pointed out a considerable overlap, but unmistakable differences in emphasis.

Karplus, Robert. "The Science Curriculum Improvement Study," Journal of Research in Science Teaching, October, 1965. Discusses the theoretical background of the project.

Karplus, Robert, Powell, Cynthia and Reynolds, Jean. "Using a Bathroom Scale," Science and Children, Vol. 1, (February, 1964), pp. 12-13. Stresses importance of bathroom scale in working with measuring process.

Karplus, Elizabeth F. and Karplus, Robert. "Intellectual Development Beyond Elementary School, School Science and Mathematics, Vol. 70, No. 5, (May, 1970), pp. 398-406. Reports on an investigation to assess abstract reasoning by using the Islands Puzzle.

Labinowich, Ed. "A Closer Look at Environmental Education," Science and Children, Vol. 8, No. 6, (March, 1971), pp. 31-35. Article comments on the life science sequence developed by SCIS in accordance with Piaget's theory of cognitive development.

Lawson, Chester A. "The Life Science Program of the Science Curriculum Improvement Study," The American Biology Teacher, Vol. 29, No. 3, (March, 1967), pp. 185-190. The life science program of SCIS for first grade is described in considerable detail by a staff member of the project.

Lawson, Chester A. "Ecology and Children," The American Biology Teacher, Vol. 33, (1971), pp. 22-25. The paper describes how the program develops the concept of ecology with elementary school children.

Linn, M. C. "Experiential science curriculum for the visually impaired" Exceptional Child Vol. 39 (Sept. 1972) pp. 37-43. Study showing success with ASMB (see Thier) SCIS program for VI children.

Linn, M. C. Peterson, R. W. "Effect of direct experience with objects on middle class, culturally diverse, and visually impaired young children; material objects unit of SCIS." Journal of Research in Science Teaching. Vol. 10, No. 1 (1973) pp. 83-90. "Study shows that direct experience with objects can lead to increases in classification ability. Also these experiences are more relevant for visually impaired and culturaly diverse children."

Linn, M. C. Thier, H. D. "Effect of experiential science on development of logical thinking in children. Journal of Research in Science Teaching, Vol. 12 (Jan. 1975). Report of SCIS vs non-SCIS fifth (and non-SCIS eighth) grades shows a significant difference in logical thinking skills.

Lockard, J. David, Compiler. "Science Curriculum Improvement Study (Karplus)," Third Report of the Information Clearinghouse (see first entry under general section), 1966, p. 57. A complete report on the project with lists of publications, availability, and future plans.

Lockard, J. David, Compiler. "Science Curriculum Improvement Study," Report of the International Clearinghouse on Science and Mathematics Curricular Developments (see first entry in general section), 1967, pp. 338-348. A brief history of the program, its purpose, comparison of the SCIS approach with that of other curriculum projects, a detailed description of materials already produced, plans for teacher preparation and for evaluation of materials.

Lockard, J. David, Compiler. "Science Curriculum Improvement Study," Sixth Report of the International Clearinghouse on Science and Mathematics Curricular Developments (see first entry in general section), 1968, pp. 197-199. Gives information in considerable detail about the staff, objectives, instructional methods, materials produced, implementation, evaluation, and future plans. In-service activities are described.

Lockard, J. David, Compiler. "Science Curriculum Improvement Study," Seventh Report of the International Clearinghouse on Science and Mathematics Curricular Developments (see first entry in general section), 1970, pp. 354, 520-528. Provided a detailed report.

McFee, E. and Lehman, R. D. "SCIS and Bilingual education in science." American Biology Teacher. (May 1973) pp. 260-261. Discussion of aspects of SCIS and reading; relationships with studies as to its effectiveness cited.

Moon, T. C. "Study of verbal behavior patterns in primary grade classrooms during science activities." Journal of Research in Science Teaching. Vol. 8 No. 2 (1971) pp. 171-177. SCIS trained teachers showed in areas "in amount of direct teacher influence displayed in verbal behavior patterns during science activities: and showed "a pronounced preference toward asking high-level questions of children.

National Science Foundation. "Science Curriculum Improvement Study," Science Course Improvement Projects, July, 1964, p. 10, Washington; U.S. Government Printing Office. A brief description of the project.

Neuberger, Harold T. "A Closed System for Natural Selection," Science and Children, Vol. 5, (May, 1968), pp. 18-20. An SCIS unit in life science for sixth grade children, investigating natural selection in which mutant strains of Drosophila are placed in a closed ecosystem and experiments are set up.

Nichols, Benjamin. "Enjoy Teaching Elementary Science," The Instructor, Vol. 75, (January, 1966), pp. 91-92. Dr. Nichols discusses basic philosophy of the experimental programs. Emphasizes the involvement of children and pacing from firsthand experiences.

Populations: a unit of life study program for third grade. Education Prod. Report. Vol. 5:6 No. 38 (Nov. 1971). Succincy overview of populations unit as a product.

Porterfield, D. "Influence of inquiry-discovery science preparation of questioning behavior of reading teachers." Reading Teacher Vol. 27, (March 1974) pp. 589-593. Study found that teachers educated in the SCIS method of teaching science would ask a greater proportion of divergent questions while teaching reading when compared to control group..

Rawitscher-Kunkel, Erika, "Algae and the Water Flea," The Instructor, Vol. 77 No. 5, (January, 1968), pp. 120-121+. A report of a curriculum study project. Describes the results of teamwork between grown-up biologists and first grade students in Berkeley, California.

Renner, J. W. et al "Evaluation of the Science curriculum improvement study." School Science and Math. (April 1973) pp. 291-318. Four year study of effectiveness of SCIS in many areas of school (reading readiness, other subjects, intellectual development) results show material objects good science program and a reading readiness program.

Schultz, Beth. "A Biotic Community with People, Your Town," Science and Children, Vol. 7, No. 2, (October, 1969), pp. 15-18. The SCIS concern to help children understand their relationship to the earth, utilizing the concept of the biotic community. Exploring the city.

Simpson, R. D. "Comparison of biologic content in three elementary school science curriculum projects ESS, SAPA, SCIS. American Biology Teacher Vol. 36 (1974) pp. 340-343. Discussion of biologic content of programs in terms of the inherent structure of the specific program.

Stafford, D. G. and Renner, J. W. "SCIS helps the first grader to use logic in problem solving." School Science and Math Vol. 71 (Feb. 1971) pp. 159-164. Using Piagetian conservation tasks, the authors show an accelerating the acquisition of conservation skills through experience found in a "normal" curriculum.

Stafford, Don G. and Renner, John W. "The First Grade Scientist," Science and Children, Vol. 7, No. 4, (December, 1969), pp. 9-11. Experiences and explorations of first graders using materials from the Organisms and Material Objects units of SCIS.

Stocking, S. "Reply and Rejoin to comparison of biologic content in 3 elementary school science curriculum projects ESS SAPA, SCIS. American Biology Teacher Vol. 37, (Feb. 1975) pp. 119-120. Letter and answer about 11/74 article an extent of implementation and amount and extent of sequential development through the grades (of the programs).

Struve, N. L. et al Effect of an experiential science curriculum for the visually impaired on course objectives and manipulative skills. Education Visually Handicapped Vol. 7 (March 1975) pp. 9-14 and Exceptional Child Vol. 40 (April 1974) pp. 516-517. Study showing superiority in content, process, logical thinking, and manipulative skills by visually impaired children using SCIS over non-SCIS VI children.

"The Necessary Nine," Grade Teacher, Vol. 85, No. 5, (January, 1968), pp. 87-90. Elementary science curriculum revision projects you should know about. All of them suggest practical ways to change your curriculum.

Thier, Herbert D., Karplus, Robert and Powell, C.A. "A Concept Matter for First grade," Journal of Research in Science Teaching, Vol. 1, (1963), p. 315. Some thoughts on science for primary grade children from one of the earliest of the elementary school science curriculum projects.

Thier, H. D. "Laboratory Science for visually handicapped elementary school children." The New Outlook for the Blind, Vol. 65 (1971) pp. 190-194. Discussion of a SMB (adapting science materials for the blind) project and its implementation of SCIS programs for visually handicapped children.

Their, Herbert D. "The Involvement of Children in the Science Program," Science and Children, Vol. 2, (Februray, 1965), pp. 19-21. Communicating for scientific literacy. Article discusses four stages of involvement: (1) reading, (2) discussions, (3) demonstrations, and (4) individual involvement. Emphasizes that goals, content, and concept development cannot be separated.

Their, Herbert D. "Quantitative Approaches to Elementary Science," The Instructor Vol. 75, (January, 1966), pp. 65-90, 93-104. Dr. Thier offers several activities and suggested grade levels for developing "How Much? How Many? How Long? How Fast?" These activities are designed to assist the children and teacher in establishing quantitative evidence. (A limited number of reprints are available for 20¢ each. The Instructor, Dept. SSR, Dansville, NY 14437).

Thier, Herbert D. "Use Rocks, Blocks and 'Structure' to Teach Concepts in Science," Professional Growth for Teachers,(March, 1965) pp. 1-2. Examination of process and structure. Three unifying concepts are discussed with examples of activities given to relate to classroom practice.

Thier, Herbert D. and Hadary, Doris E. "We can do it, too" Science and Children, (Dec. 1973) pp. 7-9. Adapting SCIS for blind children in ASMB (adapting science materials for the blind) program.

Thomson, Barbara S. and Voelker, Alan M. "Programs for Improving Science Instruction in Elementary Schools, SCIS," Science and Children, Vol. 7, No. 8,(May, 1970), pp. 29-37. Article provides an overall description of the SCIS program. It covers the nature of the program, instructional materials, use of materials, implementation and teacher programs, evaluation and the role of the teacher.

Troost, Cornelius J. "SCIS and the Problems of Right and Wrong," School Science and Mathematics, Vol. 70, (1970), pp. 522-526. He raises the concern that in teaching the SCIS program teachers might be establishing the concept that there are no facts nor authority. This he contends is contrary to the basic laws of science.

Werner, Ben. "Parallel Evolution of Elementary Science Programs in Great Britain, Japan and U.S." Science and Children (Dec. 1972) pp. 20-21. Comparison of philosophy, methodology and content of Nuffield, 5-13, ESS, SCIS, Japanese elementary science curriculum.

Wilson, John H. and Renner, John W. "The 'New' Science and the Rational Powers: A Research Study," Journal of Research in Science Teaching, 6: 303-308, vol. 6, 1969. A study in which teachers using SCIS materials used more essential school experiences, asked more questions and asked questions of a higher level than non-SCIS teachers.

Cunningham, J. S. "Rigidity in Children's Problem Solving," School Science and Mathematics, Vol. 66, April, 1966, pp. 377-389.

University of Illinois

SCHOOL SCIENCE CURRICULUM PROJECT

Funded by the National Science Foundation

School Science Curriculum Project
University of Illinois
805 West Pennsylvania Avenue
Urbana, Illinois 61801

Cunningham, John D. "New Developments in Elementary School Biology," The American Biology Teacher, Vol. 28, No. 3 (March, 1966), pp. 193-198. Gives brief description of the role of the SCIS, ESS, AAAS, and ESSP programs in teaching biology in the elementary school.

Cunningham, John D. "Elementary School Biology Revisited," Science Education, Vol. 52, No. 2 (March, 1968), pp. 181-189. A survey of the biological element in current elementary school science projects including SSCP.

Dodds, Bernard and Clark, Barbara. "School Science Curriculum," Science Education News (December, 1964). A resume of the work of School Science Curriculum Project and a progress report.

Lockard, J. David, Compiler. "School Science Curriculum Project (Evans)," Third Report of Information Clearinghouse (see first entry under general section), 1965, p. 54. A complete report on the project through March 1965, with lists of publications, availability, and future plans.

Lockard, J. David, Compiler. "School Science Curriculum Project (SSCP)," Report of the International Clearinghouse on Science and Mathematics Curricular Developments (see first entry under general section), 1967, pp. 333-335. A general report on the project.

National Science Foundation. "School Science Curriculum Project," Science Course Improvement Projects (July, 1964), pp. 14-15, Washington: U.S. Government Printing Office. A brief description of the project.

National Science Foundation. "School Science Curriculum Project," Course and Curriculum Improvement Projects (September, 1966), pp. 6-7, Washington; U.S. Government Printing Office. Philosophy, activities of the project to date and materials available.

Salinger, Richard F. P. "Progress Report: The School Science Curriculum Project," The Science Teacher, Vol. 33, No. 1 (January, 1966), pp. 36-39. Description of the project in terms of "humanistic efficiency." Outlines program and gives philosophy of the project at the University of Illinois.

Shea, James H. "School Science Curriculum Project," Geology Teachers' Newsletter, Vol. 1 (November, 1964), p. 9. The School Science Curriculum Project is a National Science Foundation supported Course Content Improvement project which is developing K-9 unit materials. Philosophy and specific objectives of School Science Curriculum Project are outlined and some preliminary units described.

Smith, James H. "Three Roles of the Physicist in Science Teaching," American Journal of Physics, Vol. 32 (November, 1964), pp. 832-934. Stress role of the physicist as curriculum building, actual teaching of physics concepts and apparatus design. Discusses briefly the two Illinois programs.

GENERAL

This section includes publications which relates to the new science in a general way but which cannot be grouped under any specific program. The section has been divided into seven categories.

A. Curriculum
B. Environmental Education
C. Science and Other Subjects
D. Psychological Foundations (inquiry, problem solving, discovery learning)
E. Teacher Education
F. Teaching Ideas
G. Miscellaneous (research, facilities, implementation, etc.)

A. Curriculum. (history, issues, background and future of the curriculum reform movement)

Lockard, J. David. Seventh Report of the International Clearinghouse on Science and Mathematics Curricular Developments. Science Teaching Center, University of Maryland, College Park, Maryland (1970). This provides a complete report of each program in science and mathematics. It is published on a yearly basis and is available for a fee of $2.00. This issue places emphasis on evaluation for each project. It also indicates which projects have become inactive.

Alexenberg, Melvin L. "Biology Education in the Elementary School: the First Task and Central Purpose," The American Biology Teacher, Vol. 29, No. 3 (March 1967), pp. 175-179. Elementary science must permit and encourage the "joy and excitement" of science. The "learn what you want--and I'll help you" stage of American education is wanted by children.

Anderson, Ronald D. "Formulating Objectives For Elementary Science," Science and Children, Vol. 5 (September 1967), pp. 20-23, and October 1967), pp. 33-36. September--Stresses importance and gives examples of setting specific objectives in teaching elementary science. October--Describes methods of evaluation of achievement of specified objectives (discussed in previous article).

Andrew, Michael D. "Schools, Science and Society," Science Education, Vol. 54, No. 4 (October-December 1970), pp. 319-324. The author discusses the prospect of developing new science curriculums that will meet the needs of our changing society.

Atkin, J. Myron. "The Elementary School Science Curriculum," The Science Teacher, Vol. 27 (March 1960), pp. 51-54. Historical developments leading to the modern curricular revisions in the elementary school science field. Emphasis on the University of Illinois program.

Avdul, Richard "The new Sciences in Elementary Education." Science and Children (October 1973) pp. 36-37. Discussion of new programs, impact and cost ramifications.

Betzon, John. "Why the 'New' School Science Doesn't Sell" Science and Children (Jan.-Feb. 1973) pp. 20-22. Discussion of attitudes of teachers towards teaching the new programs, specifically SAPA, ESS, SCIS.

Blackwood, Paul E. "Fallcut from Science Study," Science and Children, Vol. 1 (September 1963), pp. 22-23. Points up five objectives that should be achieved through the study of science, objectives that cannot be gained through other curriculum areas.

Blackwood, Paul E. "Science Teaching in the Elementary School," Science and Children, Vol. 2 (September 1964), pp. 21-22. Dr. Blackwood discusses the nature of science, purposes and methods of science teaching. He stresses the importance of the involving of children in the program.

Bloom, S. and Smith, P. "Science Curriculum, Today and Tomorrow," Science and Children, Vol. 3, No. 3 (November 1965), pp. 16-17. General outline: content, value, interest and sequential development of curriculum is presented.

Blough, Glenn O. "New Development in Elementary School Science," Education, Vol. 87, No. 4 (December 1966), pp. 215-219. The author describes projects undertaken by various organizations for the improvement of science education in the elementary school. Activities of five of the better known curriculum projects are described.

Bybee, R. "Ideal elementary science teacher: perceptives of children, pre-service and in-service elementary science teachers." School Science and Math Vol. 75, (March 1975) pp. 229-235. Arguement for emphasing inter-personal skills in pre-service training resulting from Q-sort test of importance for ideal teachers.

Calandra, Alexander. "New Science Curriculum," Education Digest, Vol. 30 (February 1965), pp. 11-14. A dissenting point of view concerning new programs in the schools. Elementary programs discussed on p. 14 of journal.

Calandra, Alexander. "The New Science Curriculums, A sharp Dissent," School Management, Vol. 8 (November 1964), pp. 76-82. A comprehensive article concerning new science curricula. Elementary through high school. A sharp dissent.

Coburn, David A. "Needed,--A Broader Interpretation," The Instructor, Vol. 79, No. 5 (January 1971), pp. 92-93. Article discusses the benefits gained from an ecological orientation to science.

DeVito, Alfred. "Models and the Curriculum," Science Education, Vol. 52, No. 5 (December 1968), pp. 457-463. A discussion of models and their use in curriculum building.

Devlin, Sister de Sales. "Examining the Curriculum in Elementary Science," Catholic School Journal, Vol. 66 (December 1966), pp. 42+. A brief discussion of the objectives of an elementary science program.

"Ecology--The Issue Behind the Science," The Grade Teacher, Vol. 86, No. 5 (January 1969), pp. 96-99. Some of the crucial issues behind the inclusion of this topic on the curriculum are raised. Several other articles in this issue deal with the teaching of the topic and mention some examplary programs.

Fischler, Abraham S. "Implications of Structure for Elementary Science," Science Education, Vol. 52 (April 1968), pp. 277-284. Discussion of the philosophy behind some of the new science approaches with an emphasis on the need for structure in any approach.

Fischler, Abraham S. "Challenge of Science Teaching Today and Tomorrow," Science Education Vol. 47 (October 1963), p. 348. Discusses several challenges of modern science programs.

Friedman, Fredrica. "The Boundaries of Elementary School Science," Science and Children, Vol. 5 (April 1968), pp. 31-32. Discussion of material to be included in elementary science program and guidelines by which to choose this materials.

Garrett, Alfred B. "For The Next Quarter Of A Century, " The Science Teacher, Vol. 36, No. 6 September 1969), pp. 20-21. Mr. Garrett suggests six new science programs which should be included in the curriculum.

Gleason, Andrew M. "Science, Math, and Tomorrow's Child," The Instructor, Vol. 77 No. 5 (January 1968), pp. 54-56. A report of the Cambridge Conference, held in the summer of 1967. The chairman of the conference reports on the ideas of scientists and mathematicians about an integrated curriculum.

Harris, William. "A Technique for Grade Placement in Elementary Science," Journal of Research in Science Teaching, Vol. 2 (March 1964), pp. 43-50. The author describes one way in which the variable of teacher effectiveness can be handled led in an experiment on grade placement, and reports on the effects of "planned instruction" on three types of thinking processes.

Heywood, Stanley J. "Toward a Sound Theory of Innovation," Elementary School Journal, Vol. 66 (December 1965), pp. 107-114. Discussion of evaluative methods of insuring a worthwhile curriculum.

Hill, Katherine. "Science for Children-Why?" Science and Children,(May 1966) pp. 11-12. Presents a goal for those working with projects in developing elementary science curriculua.

Hopman, Anne B. "Effective Change in the Elementary Science Curriculum of a School System," Science Education, Vol. 48 (March 1964), pp. 101-109. Discusses the premises,the issues, and the place of the classroom teacher in bringing change into the elementary school science program.

Hurd, Paul DeHart. "New Directions in Science Teaching, K-College," Education, Vol. 87 (December 1966), pp. 210-214. Discussion of changes taking place in science education including new curriculum developments at all levels and a plea for relating science to the humanities in education.

Hurd, Paul DeHart. "New Directions in Science Teaching," Education Digest, Vol. 32, No. 7 (March 1967), pp. 16-19. A report of an article which appeared in the December 1966 issue of Education.

Johnson, Philip G. "National Developments in Science Curriculum in Elementary and Junior High Schools," School Life, Vol. 45 (October 1962), pp. 27-30. Identifies the trends that appear to be developing in elementary and junior high school science teaching.

Jackson, Frederick H. "Key Roles of Scientists in Curriculum Change," Science Education News, (December 1961), p. 24. Brief treatment of role now being played by scientists in curriculum development.

Nelson, Pearl Astrid. "Make Haste Slowly: A Philosophy for Elementary School Science Teachers," School Science and Mathematics, Vol. 67 (December 1967), pp. 814-816. Advice as to how to meet innovations in science curriculum.

Novak, Joseph D. "The Advance of Science Education," Education, Vol. 87 (Dec. 1966), pp. 223-227. Discussion of new directions in learning theory and prediction of where science education may be in ten to twenty years.

NSTA Committee on Issues, "NSTA Positions on Critical Issues Confronting the Science Teaching Profession," The Science Teacher, Vol. 36, No. 1 (Jan. 1970), pp. 31-34. A report of general statements about policy compiled by the Committee on Issues.

Olson, Carl, Jr. "The New Programs Race," Education, Vol. 84 (December 1965), pp. 221-225. Are the "new programs" a reorganization of content or a better way of approaching time-honored objectives. Questions the acceptance by the "package" to the detriment of other equally important curriculum aspects.

Ortleb, Edward P. "Ecology in the Elementary Classroom," Science and Children, (February 1966), pp. 29-30. Gives a brief description and then an outline of teaching ecology in the upper grades.

Paschal, Billy J. "Goals for Space Age Education," School and Society, Vol. 95, No. 2295 (October 28, 1967), pp. 390-391. Since we live in an age of innovation, a practical education must prepare children for work that does not exist yet and cannot be clearly defined yet.

Pella, Milton. "Some Problems in Science Education," Journal of Research in Science Teaching, Vol. 3 (March 1965), pp. 90-92. Discusses seven basic problems confronting science education.

Piltz, Albert. "Promising Trends for Effecting Needed Changes in Curriculums in Elementary Science," Science Education, Vol. 48 (February 1964), pp. 7-12. Stresses the importance of the projects for developing better elementary science programs. Emphasizes the importance of the classroom teacher in implementing better programs.

Reznikov, L. I. "Improvement of the Content of Physics Instruction of the Eight Year School," Soviet Education, vol. 7 (June 1965), pp. 29-37. The reorganization of secondary school science makes necessary the improvement of study and the reassignment of content to the lower school and starting in the primary grades.

Sengstock, Charles A., Jr. "Trends in Science Instruction," Catholic School Journal, Vol. 67 (December 1967), pp. 45-48. Survey of contemporary methods of teaching science at all levels including use of toys, new audiovisual aids, portable laboratory equipment and teaching machines.

Shamos, Morris H. "Science and Common Sense," The Science Teacher, Vol 29 (September 1961), p. 7. Shamos calls for a major change in the structure of science education. Stresses science is all inclusive.

Sherburne, E. G., Jr. "Science Curriculum Revision and the Technological Classroom," Science Education News, (October 1962), AAAS Misc. Pub., pp. 62-10. A brief presentation of the efforts of technology in matching the subject matter reorganization in science curriculum work.

Skliar, Norman. "Marine Biology in the Elementary School," The American Biology Teacher, Vol. 29 (March 1967), pp. 226-228. Description of a program of elementary school marine biology using the ecological approach.

Slawson, Wilber S. "Bases of Science Curriculum Development in the Future," The Science Teacher, Vol. 35, No. 3(March 1968), pp. 22-26. A comparison between the conceptual school approach and the unifying themes as national in curricular development.

Stedman, C. H. "Individualized science instruction rationale and definition." Science Education Vol. 58, (1974) pp. 593-599. Steps and background for individualizing.

Stiles, Lindley and Sizer, Theodore. "To View Curriculum Development," Education Summary, Vol. 18 (November 1, 1965), p. 1. Gives reasons for supporting the introduction of information on the new curricula and new materials to education students.

Tanner, L. N. "Curriculum change in Science: Power and Processes," Education Leadership, Vol. 26, No. 6., pp. 571-575. A discussion of the forces at work in bringing about change in science curriculum. It is directed at all grade levels.

Trieger, Seymour. "New Forces Affecting Science in the Elementary School," Science and Children, Vol. 1 (October 1963), pp. 22-24. Discusses implications of high school programs on elementary school programs. Also presents aims of scientists and objectives of science teaching.

Victor, Laurence J. "Systems: An Organizing Principle for Science Curricula," Science and Children, Vol. 5, No. 5 (January-February 1969), pp. 17-20. Describes how the concept of systems can serve as a guide to the construction of science lessons.

Victor, Edward. "Controversial Aspects of the Elementary Science Curriculum Projects," Science and Children, Vol. 5 (October 1967), pp. 27-30. Review of current criticisms being made concerning the new science curriculum projects.

Weinberg, Alvin M. "Curriculum: New Math and Science Courses Called Too Narrow, Too Abstract," Education Summary, Vol. 18 (October 15, 1965), p. 2. A dissent regarding some of the new programs. While some programs are interesting and challenging many are focusing on narrowly specialized knowledge and are not including broad understanding.

Williamson, Stanley E. "Biology in the Elementary School," The American Biology Teacher, Vol. 29, No. 5,pp. 362-365. A brief history of science in the elementary school program and an evaluation of current science projects. Four of the better known projects are described.

Witlin, Alma S. "Scientific Literacy Begins in the Elementary School," Science Education, Vol. 47 (October 1963), pp. 331-342. Discusses the place of elementary science in the life and development of a child in early school years in a culture like ours.

Wilson, Evelyn H. "Urban Education: The relevant Approach, " Science and Children, Vol. 8, No. 5 (January-February 1971), pp. 11-15. Developing an approach to science free from any cultural bias. Making use of the setting meaningful to urban children, their own narrow environment.

Zafferoni, Joseph and Selberg, Edith. New Developments in Elementary Science, National Science Teachers Association, 1201-16th Street, N.W., Washington, D.C. 20036, 1963, pp. 52 ($1.50).

B. Environmental Education

Balzer, LeVon. "Environmental Education in the K-12 Span," The American Biology Teacher, Vol. 33 (1971), pp. 220-224. Some suggestions are offered for the sequence of environmental education in the elementary program.

Bybee, Rodger. Earth Science with a focus on the Child's Environment, Science and Children (Sept. 1971), pp. 11-14. Utilizing the child's environment to get motivation and learning underway.

Carlson, Jerry S. "The Environment of the Child and It's Relationship to His Achievement in Science: A Theoretical Overview," Science Education, Vol. 52 (February 1968), pp. 23-24. Achievement in elementary science and demands individual work that requires self-assertion, independence, and standards of excellence.

Environmental Education. "The Concept of Environmental Education," The Education Digest, Vol. XXXV, No. 7 (March 1970), pp. 7-11. A program urging the education of the citizenry concerning their biophysical environment, it states its major objectives.

Hawkins, Robert C. and Bonney, Catherine Y. "An Outdoor Laboratory Program for the Elementary School," The National Elementary Principal, Vol. XLXVII (February 1968), pp. 20-24. Description of educational program designed to include experience with science concepts normally not obtainable in classroom. Included are: objectives, experiences, and general survey of activities.

Haroy, Clifford and Cowan, Paul. Environmental Education and the Elementary School Science and Children (May 1971) pp. 16-17. Outdoor laboratory suggestion; discussion of balance of nature and applications in classroom; ecology club suggestions.

Horn, B. Ray. "Environmental Education A Model for Action" Science and Children (March 1973) pp. 19-21. Identifying objectives, means techniques and evaluation of an environmental ed. program.

Krockover, Gerald "Pollution Studies" Science and Children (March 1973) pp. 27-32. Specific activities in pollution studies.

Simon, Linda. Ecology a Classroom Bibliography, Science and Children (March 1971) pp. 37-38. Annotated bibliography.

Schultz, Beth "Ecology" Science and Children. (Sept. 1971) pp. 27-32. Definitions in ecology (theoretical) and ecology for the child (activities and generalizations).

Steidle, Walter E. "The Environmental Education Act" Science and Children, Vol. 8 No. 7 (March 1971), pp. 21-22. An act designed to aid teachers in developing an ecological conscience in their students. Lists means for obtaining funds.

Waterman, Alan. "The Changing Environment of Science," Science, Vol. 147 (January 1, 1965), pp. 13-18. Dr. Waterman presents a comprehensive picture of the environment of science in all aspects.

Vivian, Dr. V. Eguene and Henderson, E. L. "Environmental Education," The Instructor, Vol. 80, No. 5 (January 1971), pp. 51-62. The article summarizes all ideas on the environment and suggest activities that would bring the environment into the classroom.

C. Science and other subjects

Blanc, Sam S. "Mathematics In Elementary Science," Arithmetic Teacher, Vol. 14 (December 1967), pp. 636-640. A description of a program designed to integrate mathematics and science with emphasis on techniques to be applied in the classroom.

Calandra, Alexander. "A Program in Science and Mathematics," American Journal of Physics, Vol. 32 (November 1964), pp. 835-836. Descriptive information on a program for children grades 2-9. Course structure patterned somewhat after European and Russian system.

Coffia, William J. "Mathematics Adds to Science Understandings," The Instructor, Vol. 76, No. 5 (January 1967), p. 77. Math and science are still taught as separate disciplines, but the areas of commonality are such that one discipline serves to strengthen the other.

D'Augustine, Charles H. "Reflections on the Courship of Mathematics and Science," The Arithmetic Teacher, Vol. 14 (December 1967), pp. 645-649. Illustration of the application of math skills utilized by science.

Lewis, L. E., Jr. "The New Science is Rich in S.L.M. Relationships," The Instructor, Vol. 76, No. 5 (January 1967), p. 79. Discussion of how the process approach operates on science and how science draws from the mathematic and language disciplines in utilizing this approach.

Lewis, L. E., Jr. "Four Experiments and Demonstrations Utilizing Language and Mathematics," The Instructor, Vol. 76 (January 1967), pp. 80-89. Detailed description of materials and methods used in four elementary science experiments blending both new and traditional procedures and emphasizing the use of language and mathematics.

Liederman, Gloria F. "Math and Science Programs for the Elementary School Years," Review of Educational Research, Vol. 35 (April 1965), pp. 154-162. This article gives a short review of the new math and science projects currently in operation.

Newbury, N. F. "Quantitative Aspects of Science at the Primary State," The Arithmetic Teacher, Vol. 14 (December 1967), pp. 640-644. Stress on the quantitative approach in solving problems involving observation, discussion and recording and including illustrations of subject areas at the primary level to which the quantitative approach would be applicable.

Rosenbloom, Paul C. "Science and the New Math," The Instructor, Vol. 75 (October 1965), p. 25+. Points up the importance of mathematics in the science program at the elementary level. Examples offered.

Tucker, Jan L. "Science Education in a Changing Society," The American Biology Teacher, Vol. 29, No. 5 (1967), pp. 390-394. A social studies teacher with a particular concern for biology reports his analysis of science education and curriculum development.

D. Psychological Foundations. (inquiry, problem solving, discovery learning)

Anderson, Hans O. "Problem-Solving and Science Teaching," School Science and Mathematics, Vol. 67 (March 1967), pp. 243-250. With the emphasis on problem-solving in the new science programs, it was realized that scientific research rarely proceeds along the five linear steps known as the "scientific method"; there are as many methods as there are scientists and problems to be solved.

Binter, Alfred R. and Dewar, John A. "Teacher Commitments in a Discovery Process," Science Education, Vol. 52 (February 1968), pp. 103-104. Discussion of the discovery approach including four suggestions for making this approach more valuable to classroom science.

Boehm, Louise. "Exploring Children's Thinking," Elementary School Journal, Vol. 61 (April 1961), p. 363. A discussion involving the work of Piaget and Inhelder.

Brakken, Earl. "Inquiry Involves Individualizing," The Instructor, Vol. 78, (October 1968), pp. 95+. Suggestions as to how to individualize inquiry in science through the use of groups.

Buell, Robert R. "Piagetian Theory Into Inquiry Action," Science Education, Vol. 51 (February 1967), pp. 21-24. A discussion of Piaget's five stages of cognitive development, as they relate to children's ability to understand certain ideas in science.

Burns, Richard W. and Ellis, Barbara M. "What Is Discovery Learning?" Science Education, Vol. 54, No. 2 (April/June 1970), pp. 105-107. Author describes discovery learning as a tool used in problem solving (without a verbal solution) discusses discovery learning in relation to science teaching, and distinguishes between discovery and creative teaching.

Bybee, Rodger and McCormack, Alan. "Applying Piaget's Theory," Science and Children, Vol. 8, No. 4 (December 1970), pp. 14-17. A series of tasks which indicate a child's cognitive level, something which would be an invaluable guide in planning individualized activities.

Carin, Arthur A. "Techniques for Developing Discovery Questioning Skills," Science and Children, Vol. 9, No. 7 (April 1970), pp. 13-15. Article points out the importance of planned questioning and offers several suggestions for improving teacher questioning skills.

Chittenden, Howard A. "Piaget and Elementary Science," Science and Children, Vol. 8, No. 4 (December 1970), pp. 9-15. A "discussion of Piaget's research as it relates to pupil learning in elementary science."

Dietz, Maureen A. and George, Kenneth D. "A Test to Measure Problem-Solving Skills in Science of Children in Grades One, Two, and Three," Journal of Research in Science Teaching," 7:341-351, No. 4, 1970. Describes the development of a group test designed to measure problem-solving skills of grade one, two and three children.

Elkind, David. "Piaget and Science Education" Science and Children (Nov. 1972) pp. 9-12. Implications in sequence, methods and content.

Gessel, John K. "The Discovery Approach Applied," Science and Children, Vol. 5 (November 1967), p. 33. Brief description of a science lesson using the discovery approach.

Harmin, Merrill and Kerschenbaum, Howard and Simon, Sidney B. "Teaching Science with a Focus on Values," The Science Teacher, Vol. 36, No. 1 (January 1970), pp. 16-20. The authors discuss taking science beyond the concept level to the value level and suggest areas where this approach may be implemented.

Harlen, W. "The Development of Scientific Concepts in Young Children," Educational Research, Vol. 11, No. 1 (November 1978), pp. 4-13. A review of research concerning the development of concepts in young children.

Heffernan, Helen. "Concept Development for Science," Science and Children, Vol. 4 (September 1966), pp. 25-28. Discussion of methods of concept development in science with particular emphasis on the kindergarten and nursery school age group.

Hendricks, Robert E. "Concept Development in Science," Education, Vol. 87 (Nov. 1966), pp. 195-198. Discussion of the importance of concept development in science with particular emphasis on the kindergarten and nursery school age group.

Kersh, Bert Y. "Learning by Discovery: Inst'l. Strategies," Arithmetic Teacher, Vol. 12 (October 1965), pp. 414-417. A comparison and analysis of two basic strategies of teaching by the "discovery method"; the answer-giving behavior and the answer-seeking behavior.

Lowery, Lawrence F. and Carlson, Jerry S. "Research and Development of Science Programs: Dimensions for Consideration," School Science and Mathematics, Vol. 68 (June 1968), pp. 554-563. A discussion of the work of Piaget, Gange and others with reference to implications for science education.

Lowery, Lawrence and Allen, Leslie R. "Visual Resemblance Sorting Abilities Among First Grade Pupils," Journal of Research in Science Teaching, 6:248-256, Vol. 6, 1969. Three attributes (shape, size, pattern) were studied in sorting task situations. Shape was found easier to handle than pattern and pattern easier than size.

Neal, Louise A. "Method of Scientific Inquire," The Science Teacher, Vol. 29 (September 1962), pp. 52-53. Techniques for developing methods of scientific inquiry for elementary age children.

Neal, Louise A. "A Discovery Approach for Developing Productive Thinkers," Science and Children, Vol. 2 (November 1964), pp. 16-17. Brief report of a K-6 program in discovery at Colorado State College, Greeley.

Perrodin, Alex F. "Children's Interests in Elementary School Science," School Science and Math, Vol. 65 (March 1965), pp. 259-264. What do fourth, sixth, and eighth grade students like about science? What do they like least? (boring lectures, writing down everything, etc.) Like: (liked "experiments",)

Piaget, Jean. "Cognitive Development in Children: Development and Learning," Journal of Research in Science Teaching, Vol. 2 (September 1964), pp. 176-186. Piaget's article emphasizes implications for his approach toward educational practice.

Ramsey, Irvin L. and Miandt, Sandra Lee. "Individualizing Elementary School Science," School Science and Mathematics, Vol. 67 (May 1967), pp. 419-427. A study of effects of individualizing elementary science using the inquiry approach in one elementary school. A review of methods and materials used and procedures for evaluation are given.

Renner, John W. "A Case for Inquiry," Science and Children, Vol. 4 (March 1967), pp. 30-33. Presentation of reasons for using an inquiry-centered science program and discussion of the teacher's role in such a program.

Renner, et. al. "Piaget is Practical", Science and Children, (October 1971), pp. 22-26. Data on conservation tasks in classrooms.

Ruchlis, Hy. "Understanding Elementary Science Education," School Science and Mathematics, Vol. 64, p. 388. Discusses the vital importance of understanding the characteristics of elementary school children in science curriculum change.

Scott, Norval, C., Jr. "The Strategy of Inquiry and Styles of Categorization," Journal of Research in Science Teaching, Vol. 4 (September 1966), pp. 143-153. Report of an experiment testing effects of a method of inquiry teaching upon students' ability to categorize.

Shulman, Lee S. "Psychological Controversies in the Teaching of Science and Mathematics," The Science Teacher, Vol. 35, No. 6 (September 1968), pp. 34-38+. A discussion of discovery learning as Bruner or Gange might see it.

Stendler, Celia. "Elementary Teaching, and the Piagetian Theory," The Science Teacher, Vol. 29 (September 1961), p. 34. An attempt to put the theories of Piaget into "plain English" and point out the pedagogical implications for elementary science.

Suchman, J. Richard. "Inquiry," The Instructor, Vol. 75 (October 1965), p. 26+, (November 1965), p. 30+, (December 1965), p. 26+, (January 1966), p. 24+.

Discussions of inquiry, conditions of inquiry and the place of inquiry in the curriculum, freedom to learn and the need for "focus" upon inquiry showing the teacher as the "key" in the process. October--"Inquiry," November--"The Conditions for Inquiry," December--"Inquiry," and January--"Inquiry in the Curriculum."

Taylor, Alton L. "The Influence of Teacher Attitudes and Individual Differences on Pupil Achievement with Programmed Science Materials," Journal of Research in Science Teaching, Vol. 4, No. 1 (1966), pp. 38-40. A study employing fourth grade children taught with programmed science and materials.

Thomas, Patricia Grafton and Buell, Robert R. "Piagetian Studies in Science: Perception and Rendering of Form by Children," Journal of Research in Science Teaching, Vol. 5, No. 1 (1967-1968), p. 36. Purpose of the study was to determine whether a relationship existed between developmental age and the ability to internalize and reproduce three dimensional forms in 2 dimensions.

Wightman, Mary Alice. "The Secret of Discovery," The American Biology Teacher, Vol. 28 (October 1966), p. 609. Description of successful lesson taught using the "discovery" method.

Young, Darrell D. "Inquiry-A Critique," Science Education, Vol. 52 (March 1968), pp. 138-141. Advantages and limitations of the inquiry approach to teaching science.

E. Teacher Education.

Ballou, Mildred T. "Science Methods Courses for Elementary Teachers," Science and Children, Vol. 7, No. 1 (September 1969), pp. 7-9. Suggested improvements for instructors in science methods courses at the college level.

Balzer, Levan and Parakh, Jal S. Pre-Service Mini-teaching, Science and Children (April 1971) pp. 24-27. Program at W. Washington St. College (Bellingham Washington) mini-teaching, science packets and peer teaching.

Blanc, Sam S. "Creative Thinking for the Process Skills," Science and Children, Vol. 4 (May 1967), pp. 6-7. Discussion of teaching science to develop the process skills and analysis of the teacher's role in using this method.

Cunningham, Rodger. "Implementing Nongraded Advancement with Laboratory Activities as a Vehicle--An Experiment In Elementary School Science," School Science and Mathematics, Vol. 67 (February 1967), pp. 175-181. Detailed description of a nongraded approach to science utilizing inquiry.

Curtis, William C. "New Perspectives in Science Teaching," School Science and Mathematics, Vol. 66, No. 7 (October 1966), pp. 655-660. A discussion of teacher training needs in view of the likely shift to processes in the elementary grades and more content in senior area.

Curtis, William C. "Teacher-Training for Process Oriented Science Instruction," Science Education, Vol. 51 (December 1967), pp. 494-498. Most teacher preparation in science has very little consideration of scientific processes. The author attempts to analyze the components of such a preparatory program.

"The CCSS Program of the National Science Foundation," Science and Children, Vol. 5 (March 1968), pp. 24-25. General description of the CCSS program including a list of participating institutions, project directors, and information pertinent to each project.

Kranzer, H. C. "Children and Their Science Teachers," Journal of Research in Science Teaching, Vol. 1 (June 1963), pp. 177-183. This article explores the realm of the child's world for fruitful leads in the preparaiion of elementary school teachers of science. Teachers need a better preparation in the behavioral and natural sciences.

Menzel, F. Wesley. "Teaching Elementary Science," School Science and Math, Vol. 64 (February, 1964), pp. 146-147. Deals with the "new tone" in teaching elementary science. Stresses the importance of considering the differences in children's backgrounds. Points out that the method of inquiry can vary with each pupil.

Rosen, Sidney, Weller, Charles M. and Gaides, G. Edward. "Science and Methods for Teachers-To-Be." The Elementary School Journal, Vol. 69, No. 3 (December 1968), pp. 137-142. A discussion of implications for teacher education arising out of the non-science programs.

Ritterbush, Philip C. "Science Teaching and the Future," The Science Teacher, Vol 36, No. 6 (September 1969), pp. 32-39. The author describes several new approaches to science which teachers must begin to concern themselves with.

Thiery, Herbert D. "The Role of the Elementary School Teacher in Relation to the Curriculum Reform Movement," Science Education, Vol. 51 (April 1967), pp. 282-286. Emphasis on the importance of the teacher and her knowledge of the pupil in development of new science curriculum.

Thompson, J. L. "A New Method of Teaching Science," Science Education, Vol. 48 (October 1964), pp. 90-92. An outline of a series of lectures given in England on content and methods of science teaching. A dogmatic type of instruction is avoided and newer methodology is emphasized.

Westmeyer, Paul. "Cooperative Science Curriculum Development," Education, Vol. 87, No. 4 (December 1966), pp. 220-222. The author describes the development of a new chemistry course in San Antonia, Texas. The project was noteworthy because it involved the cooperation of local state, and national agencies.

F. Teaching Ideas.

Andrew, Michael D. "Elementary School Science: Alternative for the Teacher," Science and Children, Vol. 6 No. 8 (May 1969), pp. 17-19. Some guidelines for teachers are presented for developing a modern science curriculum.

Boulos, Sami. "Are You Teaching Science Unscientifically?" Science and Children, Vol. 2, No. 7 (April 1965), p. 25. Is science a matter of perceiving or being told?

Cooper, Lloyd G. and Willis, Connie. "Your Classroom As A Science Lab," Grade Teacher, Vol. 88, No. 1 (September 1970), pp. 96-97. Two approaches that made science meaningful in the classroom.

Cobin, Michael R. "Developing a Teacher's Awareness of Children," Science and Children, Vol. 8, No. 5 (January/February 1971), pp. 24-26. A program which emphasizes classroom experience in teaching training programs in order to come to a better understanding of children.

DeRoche, Edward F. "Some Creative Activities In Elementary Science," Catholic School Journal, Vol. 67 (December 1967), pp. 54-55. A list of several creative excercises used in a study of creativity and science achievement done by the author.

Dixon, Nancy. "Science On Saturday," Cathloic School Journal, Vol. 67 (December 1967), pp. 48-50+. Description of an innovative science program (behavioral objectives, units) designed for a group of disadvantaged fourth, fifth and sixth grade children.

Gray, Joan E., Gross, Helen E. and Struthers, Joseph A. "From Egg to Egg in Nine Weeks," Science and Children, Vol. 5 (November 1967), pp. 9-13. An account of a project in which Japanese quail were hatched in some elementary classrooms in Boulder, Colorado.

Hand, Jackson and McGavock, John. "A Way to Teach Science for Every Teacher for Every Grade," The Grade Teacher, Vol. 82 (January 1965), pp. 40-67. This article gives lesson plans for teaching the following units: Balance board, cell, hydrophonics, crystals.

Hart, Hazel C. "Classroom Structures Rapidly Changing, " Education, (Dec. 1965), pp. 195-201. In a general summary of the changing classrooms for all subjects, the new science is treated with respect to its goals and the importance of laboratory-type experiences.

Lansdown, B. and Dietz, T. "Free Versus Guided Experimentation," Science Education, Vol. 49 (April 1965), pp. 210-213. Definition of Open-ended, Free-guided and Discovery approach with experimentation on the two.

Levine, Sheldon. "How to Get Started in the New Science," Grade Teacher, Vol. 85, the discovery approach are cited from the Mahopac, N. Y. project.

Lipson, Joseph I. "An Indiviaualized Science Laboratory," Science and Children, Vol. 4 (December 1966), pp. 8-12. Description of an experimental individualized laboratory-type science program developed at the University of Pittsburgh for use with readers and non-readers in grades K-6.

O'Toole, Raymond J. "A review of Attempts to Individualize Elementary School Science," School Science and Mathematics, Vol. 68 (May 1968), pp. 385-390. A review of attempts to individualize elementary school science, with a description of methods used. AAAS, SCIS and ESS programs all lend themselves to individualization procedures.

Paige, Joseph C. "Disadvantaged Children and Their Parents," Science and Children Vol. 2 (March 1965), pp. 11-13. Description of Howard University's Elementary Science project for disadvantaged children and their parents. Information available from Dr. Joseph C. Paige, Howard University, Wash. D.C.

Paige, William M. "Elementary Teaching Roadblocks," Science Teacher, Vol. 30 (April 1963), pp. 23-25. The person not specializing in science finds in its study a number of "roadblocks" (fear of teaching science, feeling of incompetence, strange ideas, too difficult, etc.). Improvement lies in teacher creating a classroom atmosphere which relaxes tension and encourages learning and accomplishment as its own satisfying reward.

Robarge, Thomas J. "Science Equipment Library," Science and Children, Vol. 4 (Febuuary 1967), pp. 27-28. Description of a teacher-student library of especially designed science kits which students may check out for home use. Experimental project in DeKalb, N.Y., financed by Title I.

Rodrique, Elizabeth. "The Effect of an NSF Institute on Teaching Science in a First Grade Classroom," School Science and Mathematics, Vol. 63 (Feb. 1963), pp. 84-88. This article reviews the author's experiences in a first grade class after attending an NSF Institute. NSF experience helped to teach science,health, health habits and other areas to her class.

Ruchlis, Hy. "How precise Shall We Be," Physics Teacher, Vol. 2 (April 1964), p. 175. This is a letter-to-the-editor, answering J. W. Buchta's editoral in January 1964 Physics Teacher. In the area of elementary science the preciseness cannot be answered soley in terms of reference to subject matter.

Samples, Robert E. "Notes on Teaching Science," Science and Children, Vol. 5 (March 1968), pp. 28-30. Presentation of idea that science is flexible as well as factual. Suggestions given for teaching problem solving using both intuitive and substantive material.

"Science Among the Bricks and Mortar," The Science Teacher, Vol. 36, No. 9 (Dec. 1969), pp. 27-31. A series of articles in which science educators describe how they have incorporated both the mountain and inner-city environments into their science programs.

Schippers, John V. "Why Not Discover the Law of the Lever?" Science and Children Vol. 2 (November 1964), pp. 5-7. A discussion of the lever as a vehicle for learning by discovery.

"Science Teachers Advised to Base Lessons Upon the Child's Wonderment at Nature," Education Summary, Vol. 20 (November 1, 1967), p. 6. Two examples of how teachers built a science lesson by capitalizing on a moment when children expressed curiosity.

Shepherd, Gene. "Language is the Key to Science Learning," The Instructor, Vol. 76, No. 5 (January 1967), p. 75. The role of language in the new science programs.

Sours, Charles V. "The Personal Interview as a Tool in Process Teaching," School Science and Mathematics, Vol. 67 (June 1967), pp. 503-506. A plea for the use of personal interview in the teaching of science including description of several experiments utilizing this method.

Subarsky, Zachariah. "Communication: A Goal of Elementary Science Teaching," Science and Children, (March 1966), pp. 18-19. Stresses importance of communication and gives some activities which the science teacher could use to improve it.

Sherman, Jack. "A Science Opener," Science and Children, Vol. 8, No. 6 (March 1971), pp. 28-29. A new way to start a science program. A kit designed to develop enthusiasm and interest in further science activities.

Webster, John W. "A Science Program for the Disadvantaged Child," Science Education, Vol. 54, No. 1 (January/March 1970), pp. 49-53. The author offers teachers some procedures and techniques which prove to be very helpful when working with disadvantaged children.

G. Miscellaneous (research, facilities, implementation, et cetera)

Atkin , J. Myron. "Science in the Elementary School," Review of Educational Research, Vol. 34 (June 1964), pp. 263-272. Reviews research in areas of children's science concepts, teaching science, children's interests, curriculum, and instructional materials and organization.

Atkin, J. M. "Some Evaluation Problems in a Course Content Improvement Project," Journal of Research in Science Teaching, Vol. 1 (June 1963), pp. 129-132 In this article, Atkin brings into sharp focus one of the imporatnt issues of the day: The related questions of when, how and by whom learning goals should be stated in curriculum building and suitability of tranditional procedures for evaluating them.

Belange, Maurice. "Study of Teaching and the New Science Education Curricula," The Science Teacher, Vol. 31 (November 1964), p. 31. Brief survey intended to call attention to the importance of considering what events take place in the classroom between teachers and pupils, and suggest a few avenues of study.

Blosser, Patricia E. and Howe, Robert W. "An Analysis of Research On Elementary Teacher Education Related to the Teaching of Science," Science and Children, Vol. 6, No. 5 (1969), pp. 50-60. A discussion of the reaearch in this area; included an excellent set of references.

Bradley, R. C. and Earp, N. Wesley. "A Method of Producing Up-to-Date Science Material for Elementary Children, " Journal of Research in Science Teaching, Vol. 4, No. 2 (1966-67), pp. 102-105. A study involving the rewriting of an article from Scientific American for grade six children.

Brautigan, Walter F. "Recent Science Materials," The Instructor, Vol. 70 (Jan. 1967), pp. 100-101+. List of materials available, date published, author, publisher, and short description of several projects.

Brehm, Shirley A. "The Impart of Experimental Programs on Elementary School Science," Science Education, Vol. 52 (April 1968), pp. 293-297. Discussion of experimental curriculum projects on the elementary level: their similarities, their implications and impact, and reasons why they are being developed.

Burnett, R. Will. "On the Improvement of Research in Science Education," Journal of Research in Science Teaching, Vol. 1 (1963), p. 253. Ideas expressed for the improvement of research in science education. Six major points given.

Butts, David P. "The Price of Change," Science and Children, Vol. 6, No. 7, (April 1969), pp. 7-8. A brief discussion of the costs involved in implementing the newer programs.

Dillman, Duane H. "The U. S. Office of Education and Science Teachers," The Science Teacher, Vol. 34, No. 6 (September 1967), pp. 23-26. Discusses help, financial and otherwise, available to science teachers and science program through the U. S. Office of Education.

Fischler, Abraham. "Science, Process, the Learner: A Synthesis," Science Education (December 1965), pp. 402-409. Is inquiry being properly taught? The teacher's role, the nature of inquiry and the cognitive process are discussed. Examples from SCIS, ESSP, ESS, PSSC, CBA and CHEM are given.

Francis, SSJ., Sister James. "The A, B, C's of Science Education," Catholic School Journal, Vol. 65, No. 6 (June 1965), pp. 39-40. Creative use of alphabet to briefly define new terms and programs in science education.

Frazier, Calvin M. "A School Administrator Considers the Adoption of a New Program," Science and Children, Vol. 5 (March 1968), pp. 9-12. Description of a five-step systematic process designed to aid administrators in the adoption and implementation of a new elementary science program.

Goodall, A. M. "The Process Approach to 6th Grade Science," Independent School Bulletin, Series 63-64 (May 1964), pp. 35-37. Describes the procedure followed in defining and implementing a 6th grade curriculum that emphasizes the processes of science.

Hausman, Howard J. "The Cooperative College-School Science Program of the National Science Foundation," Science and Children, Vol. 4 (March 1967), pp. 26-27. An analysis of two years' work in a program which has college personnel cooperating with elementary and secondary schools to provide inservice for teachers. The need of college instructors who are able to give help with the new elementary science programs was noted.

Heffernan, Helen. "Do Our Elementary Schools really Teach Science?" Grade Teacher, Vol. 82 (January 1965), pp. 32 and 130. Miss Heffernan asks: Are students really learning the methods of science: observation, experimentation, inquiry, accurate record-keeping? Or are they merely reciting facts from the text, what scientists have already discovered?

Heldman, Lawrence J. "Planning a Science Facility," Science and Children, Vol. 4 (February 1967), pp. 17-19. Checklist and general discussion of equipment and facilities needed to remodel a school room into an elementary science facility.

Lawlor, Francis X. "The Effects of Verbal Reward on the Behavior of Children in the Primary Grades at a Cognitive Task Typical of the New Elementary Science Curricula," Journal of Research in Science Teaching, 7:327-340, No. 4, 1970. A study of the effects of verbal reward on children performing sorting tasks typical of those found in SAPA, ESS and SCIS. Noncongruent regards improve problem solving for girls, but not boys.

Livermore, Arthur H. "Curriculum Research in Science," The Journal of Experimental Education, Vol. 37, No. 1 (Fall 1968), pp. 49-55. A general description of the development in science curriculum from K-12.

Lerner, Marjorie S. "Inservice Science Activities," Science and Children, Vol. 4 (November 1966), pp. 21-23. Brief survey of eight sources through which the elementary teacher can obtain training in the teaching of science.

Lunn, Mervel S. "Many Materials Serve the Science Program," The Instructor, Vol. 76 (January 1967), p. 94. Emphasis on the use of the multimedia approach in teaching science, including a list of materials basic to an adequate science center.

Mattera, Gloria and Alexander, Rosemary. "New Science Equipment and Materials," The Instructor, Vol. 77 (January 1968), pp. 122-123. Description of science equipment and materials including the ordering address for all and prices of some.

Molyneaux, Marjorie B. "Choosing Elementary Science Equipment," Science and Children, Vol. 4 (February 1967), pp. 20-21. Brief review of some of the equipment necessary for the elementary science program. Includes discussion of science tables, animal cages, audiovisual equipment, microscopes, and models and kits.

Munson, Howard R. "Evaluating the New Science Teaching," Elementary School Journal, Vol. 68 (December 1967), pp. 126-130. Discussion of concrete methods of evaluating the elementary child's progress in such areas as predicting, drawing inferences, forming hypotheses and development of science skills.

"National Elementary Science Curriculum Projects," Science and Children, Vol. 5 (March 1968), pp. 22-23. The editors have compiled a chart which lists ten of the better known curriculum projects in elementary science. Pertinent information is given for each.

"National Elementary Science Curriculum Update," Science and Children, Vol. 8, No. 1 (September 1970), pp. 30-31. The editors have compiled a chart of the better known curriculum projects in elementary science. Pertinent information is given for each.

National Science Teachers Association Staff Report. "Shock Waves in Education," The Science Teacher, Vol. 33 (September 1966), pp. 15-17. A report of the ways in which some schools are using funds from the ESEA to improve science instructions.

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